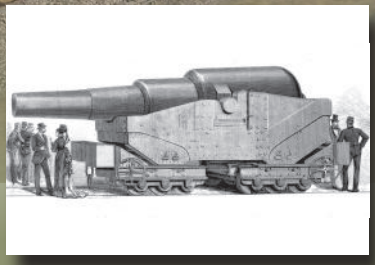
SUPERGUNS 1854–1991

Extreme artillery from the Paris Gun and the V-3 to Iraq's Project Babylon



STEVEN J. ZALOGA

ILLUSTRATED BY JIM LAURIER

NEW VANGUARD 265

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SUPERGUNS 1854–1991

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INTRODUCTION

This book examines some of the extreme examples of army artillery of the modern era. The power of artillery can be measured in various ways, including the weight of the projectile and the range of the gun. In terms of technology, long range has usually proved to be a greater challenge than the weight of the projectile. This is the criteria used in most of the examples described here.

Rather than simply catalog the many cannon that might fit these criteria, this book covers four major eras and focuses on a particular weapon from that period. This permits a more in-depth look than would be possible by a shallow encyclopedia overview. The four eras covered in this book are World War I, World War II, the Cold War, and the "New World Disorder."

Monster guns can be traced back centuries. The Tsar Pushka, a cast-brass 890mm bombard, was built in Moscow in 1586 and currently resides within the Kremlin walls. It may have been test fired, but it never fired a shot in anger. It was meant to fire 800kg stone balls; those in front of the gun are more recent additions.

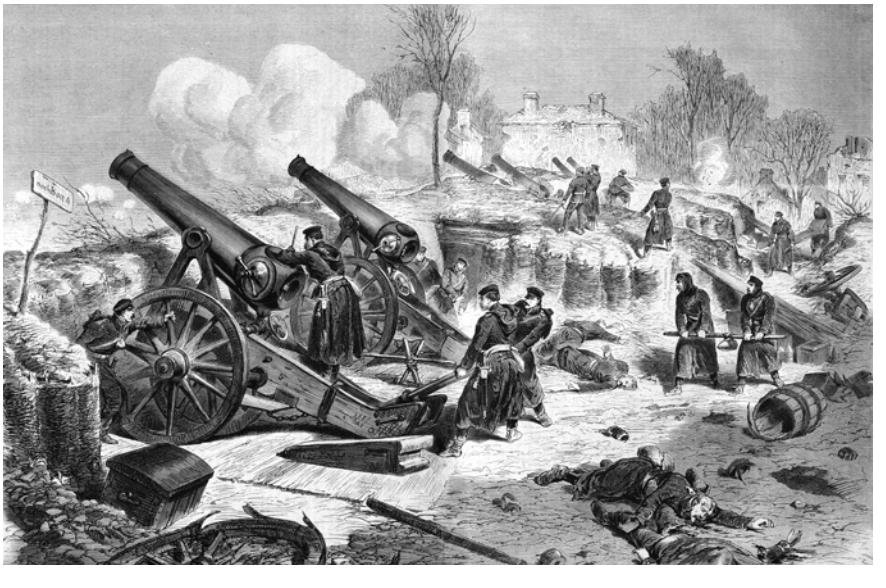
This book avoids railroad guns, since they have been covered in two previous books in this series.[1] It also skirts around coastal defense guns due to their close association with naval artillery. Some of these types of weapons are mentioned, however, mainly to provide benchmarks for contemporary artillery.

Prelude to modern artillery

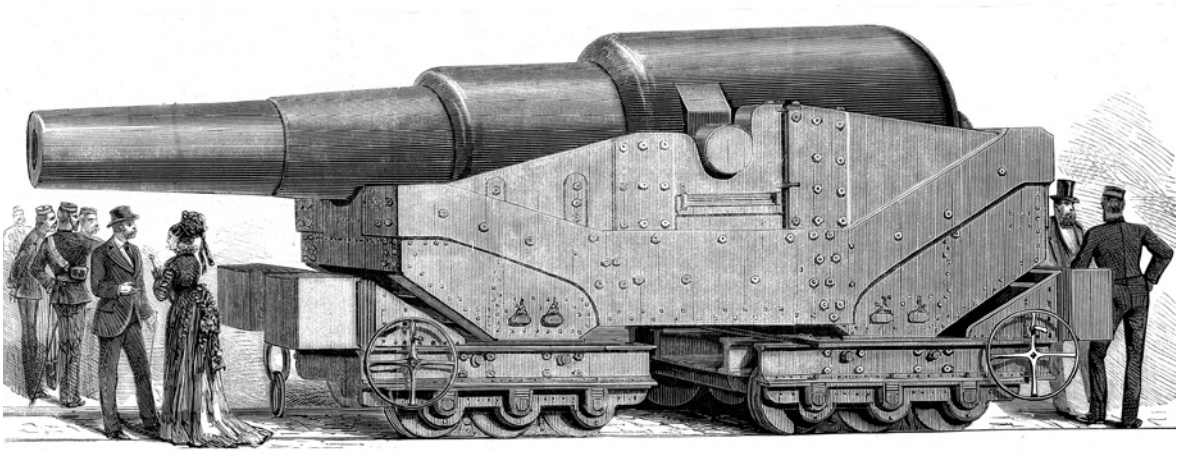
The watershed in modern artillery development occurred in the second half of the 19th century in the wake of the Crimean War. The shortcomings of field artillery in that conflict prompted a spurt of technological innovation. A good example was the British inventor, William Armstrong, who designed many of the innovative cannon of this era.

The Armstrong field guns used rifled tubes with elongated projectiles that offered superior accuracy and power compared to traditional smooth-bore cannon firing round ball ammunition. In addition, the Armstrong guns marked a shift away from muzzle-loading to breech-loading, which facilitated a higher rate of fire and a superior ability to adjust shot after a first round. Finally, Armstrong applied new metallurgical techniques, notably the use of built-up ring construction on the barrel, which enabled his cannon to fire large projectiles using more powerful propellant loads. Many of these technologies had been attempted by previous cannon designers, but Armstrong was able to blend these novel approaches to produce a superior cannon. Armstrong's first 3-pdr of 1855 demonstrated superior penetration to comparable pieces of the day, and his designs steadily increased in size and power. The obvious advantages of his cannon led the British government to fund a new factory in Elswich near Newcastle, both for further development and also for manufacture. The Elswich Ordnance Works was a pioneer in artillery design for the next half-century. Competition ensued in Britain by other new designers such as Joseph Whitworth, as well as in other countries such as Alfred Krupp in Germany.

1 Marc Romanych and Greg Heuer, *Railway Guns of World War I*, New Vanguard 249 (Osprey: Oxford, 2017); Steven J. Zaloga, *Railway Guns of World War II*, New Vanguard 231(Osprey: Oxford, 2016).



Compared to naval guns, heavy field artillery in the late 19th century was quite puny due to the limitations of horse traction. This contemporary illustration from the January 21, 1871, edition of *Illustrirte Zeitung* shows Belagerungsbatterie Nr. 3 near Raincy during the bombardment of Paris in the 1870–71 Franco-Prussian War. Due to its stationary nature, *Festungsartillerie* (fortress artillery) were the most powerful of the Prussian guns and were deployed as siege artillery during the conflict. The Prussian 150mm (24 Pfünder) C/61 as seen here was a breech-loaded gun that lacked any form of recoil system.



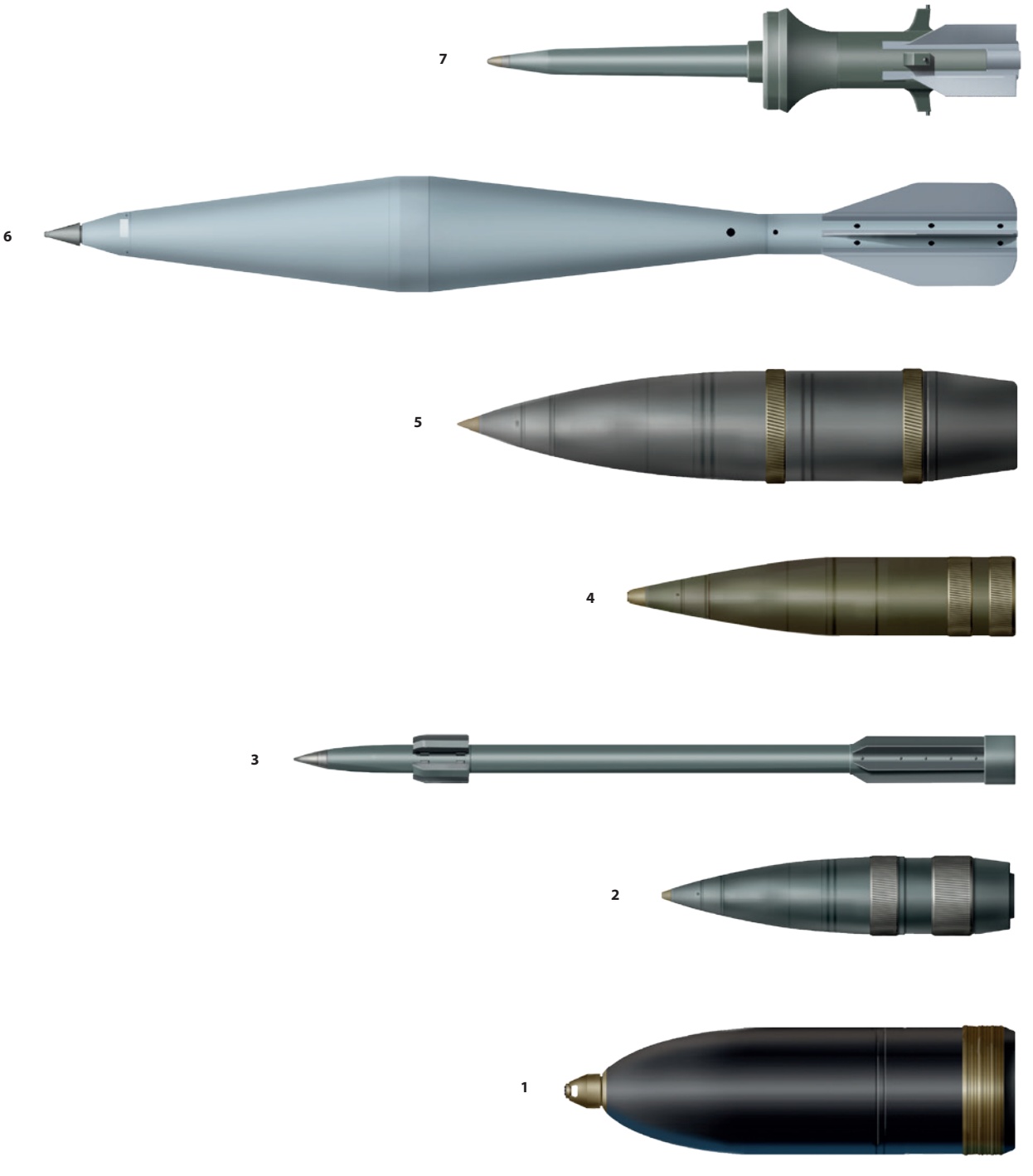
One of the last of the rifled muzzle-loading "Monster Guns" was this RML 16in. 81-ton gun manufactured at the Royal Arsenal in Woolwich. Four of these armed HMS *Invincible* in 1880 and two more were used in the coast defense turret at the Admiralty Pier Fort in Dover, where they remain today. Breech-loading guns subsequently superseded the muzzle loaders. This illustration was printed in *The Pictorial World* on September 25, 1875, after the successful trial of one of the guns.

The catalyst for artillery design in the late 19th century was the advent of ironclad ships. Once warships began to appear with armored hulls, there was a need for cannon capable of penetrating their armor. This became evident during the first clash of armored warships, the duel between the USS *Monitor* and CSS *Virginia* in Hampton Roads on March 9, 1862. Both ships battered each other for hours, but their cannon were not powerful enough to penetrate the armor of their opponent even at point-blank ranges. Armstrong had already outfitted the British ironclad HMS *Warrior* with rifled 110-pdrs, but these guns could not penetrate the 4½in. iron plate being applied to warships such as the French ironclad *La Gloire*. These large naval guns were muzzle loaders, since breech technologies were not yet durable enough for use on the most powerful cannon. Armstrong responded with further innovations, including an improved rifling technique and further enlargement of his cannon. Aside from their employment on warships, these new guns were essential for coastal defenses. Armstrong delivered a 300-pdr in 1862 to the Shoeburyness firing range. The success

A

Ammunition of the Super Guns

Projectile	Gun	Caliber (mm)	Weight (kg)	High-explosive equivalent (kg)	Initial muzzle velocity (m/s)	Range (km)
1. Common shell for 111 ton gun	Elswick BL 16.25in.	410	815	200	615	13
2. Sprenggranate	Wilhelm-Geschütz	210	105	7	1,645	120
3. Sprenggranate 4481	15 F 58 HDP	150	97	9	911	45
4. W9 (Mk. 9)	Atomic Annie	280	365	15,000	765	24
5. Kondensator-AP	2A3 Kondensator	406	570	14,000	~750	25.6
6.Transformator-AP	2B1 Oka	420	650	~12,000	~750	25
7. S32	System 350	350	135	0	2,000?	420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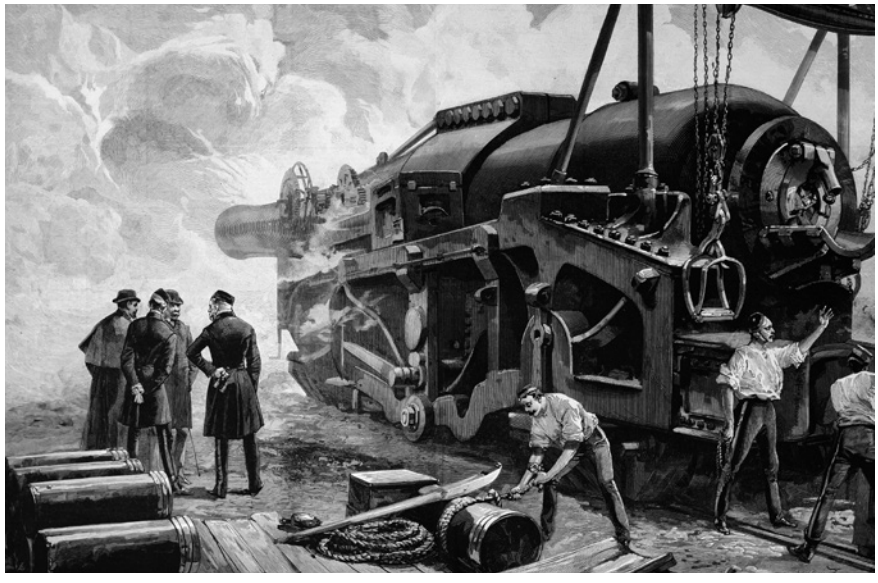


An impressive illustration captioned as "the largest gun in the world" from the *Illustrated London News* of June 11, 1887, showing the Elswick BL (breech-loading) 16.25in. gun during trials at Woolwich. This particular 111-ton weapon was destined to be mounted on the battleship HMS *Benbow*. It fired a 1,800lb projectile using 960lb of burning prismatic brown powder. This gun was the culmination of Armstrong's hoop construction with the barrel consisting of 42 parts, including the barrel itself, the breech, 15 hoops in the second layer, 11 in the third layer, eight in the fourth layer, and six in the fifth layer. This type of construction gave way later in the century to machined steel designs.

of these tests led to a profitable export market for Armstrong's "monster guns" and they were sold to several countries, both as warship armament as well as for coastal defense.

The pace of innovation continued into the late 1800s. Aside from gun design, there was significant development of propellant technology. Traditional black powder is very fast-burning. Newer propellants were developed such as cordite that burned more slowly and offered sustained power. New metallurgical advances, particularly advances in the casting and machining of steel, marked another leap forward in gun design after 1880.

Army field artillery in the 19th century was quite puny by naval standards, for the obvious reason that the size and weight of the cannon were limited by horse traction. The exception to this was fixed coast artillery, which was usually a land-based derivative of existing naval guns. Motor traction for army artillery did not become common until World War I. Even with the advent of various types of prime movers, army guns remained relatively small compared to their naval counterparts since the existing vehicle technology and road networks placed a limit on the size and weight of cannon. In addition, field artillery had traditionally relied on direct-fire weapons that could engage targets visible to the gunner. It took some time for field artillery to adapt to the potential for long-range, indirect fire made possible by the new gun technologies.

There were two exceptions to these trends in field artillery by 1914. Some very heavy artillery was developed for army use to attack forts. These siege guns, often heavy mortars or large-caliber howitzers, were transported as smaller subcomponents and then assembled opposite the target in a fixed position. These types of heavy siege guns were pioneered by Krupp in Germany and Škoda in Austro-Hungary. The second exception was the railway gun. Mounting heavy weapons to railway platforms began during the American Civil War, but railway guns were not numerous until World War I. Railroads could transport cannon that were much larger than those that were towed by motor transport. The early railroad guns of 1914–15 were often adaptations of naval guns.

WILHELM-GESCHÜTZ: THE PARIS GUN

The Imperial German Navy deployed a number of land-based heavy guns between 1914 and 1918, derived from their warship weapons. Its most extensive commitment was Marine Korps Flandern, used to protect its naval bases on the Belgian coast. This is Batterie Pommern, armed with the most powerful gun of its day, the "Lange Max," a 380mm SK L/45 naval gun intended for the Bayern-class battleships. This gun was deployed in a turreted mount near Leugenboom and first fired on Dunkirk on June 27, 1917. It had a range of over 50km.

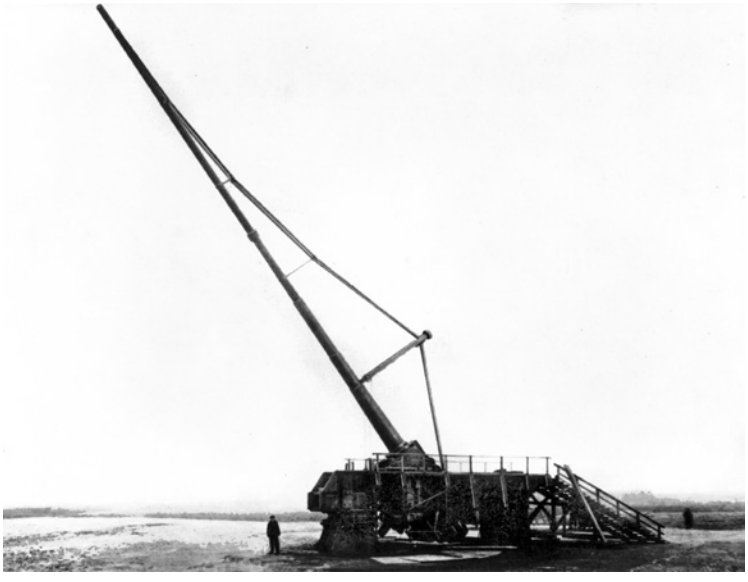
The Great War battlefield was dominated by artillery. Machine guns and rapid-fire field guns swept the battlefield of traditional horse cavalry, and made it very difficult for infantry to advance across open terrain. The stalemate of trench warfare ensued. Static defenses were an ideal target for artillery, and the number and power of field guns escalated steadily from 1914 to 1918. The pinnacle of World War I guns was the so-called "Paris Gun," the longest-range cannon to see combat in the war, and arguably the first of the "superguns."

The development of heavy, long-range artillery in Germany was dominated by the Krupp firm, based in Essen. Three types of heavy artillery emerged in the first years of the Great War: siege guns, railway guns, and coastal guns. The early German railway guns and coastal guns were usually derived from existing naval artillery, but using new mounts for their different role. The epitome of artillery firepower in 1914 was Krupp's 420mm Gamma-Gerat, better known to the Allies as the "Big Bertha."[2] This fixed-site howitzer fired a 760kg (1,680lb) projectile to a range of up to 13km (8 miles). This weapon was ideally suited to positional warfare, especially the bombardment of fortifications. For greater range, the German navy deployed a small number of surplus 380mm naval guns for the "Schwerstes Flachfeuer" (Super-heavy, flat trajectory) role on a fixed ground mount. These were deployed opposite French forts along the frontier. German naval guns were later deployed with the Marine Korps Flandern on fortified mounts along the Flanders coast. The most extreme example of these weapons was the Batterie Pommern at Leugenbook, armed with a 380mm naval gun, which bombarded Ypres and Dunkirk.

Railway artillery offered superior flexibility and eventually the naval 355mm L/53 gun was adapted for railway use, offering a range of up to 57km (35 miles) firing a 325kg (720lb) projectile. The largest contemporary German naval gun adapted to railway mounting, the 380mm L/45, offered somewhat less range, 43km (27 miles), but with a much heavier projectile of 1,050kg (2,240lb).

The German army came tantalizingly close to Paris in 1914, but lacked weapons with sufficient range to bombard the city. The individual most closely connected with the Paris Gun was Prof Dr Fritz Rausenberger, artillery chief at Krupp. The firm had already begun to study super-long range ballistics for the navy using a new generation of low-drag, aerodynamically shaped projectiles. There were suggestions from Prof Otto von Eberhard to use the 355mm L/52 naval gun with a reduced-weight 210mm projectile in a sabot that could reach ranges over 100km. Discarding sabots are metal jackets attached to a subcaliber projectile to permit it to be fired from a larger bore; the sabot falls away after exiting the barrel. The advantage of subcaliber, discarding-sabot projectiles is that they can use the larger propellant load

2 Marc Romanych and Martin Rupp, *42cm 'Big Bertha' and German Siege Artillery of World War I*, New Vanguard 205 (Osprey: Oxford, 2014).



The Wilhelm-Geschütz required a truss over the gun to suspend a set of cables that were used to straighten the barrel due to the natural droop of such a long and narrow gun tube. This is a view of the gun at the Altenwalde proving ground.

of a heavier gun, while at the same time being significantly lighter than the normal projectile, thereby having greater range.

Rausenberger argued that Eberhard's approach was tactically suspect since the subcaliber projectile weighed only 90kg. Furthermore, the discarding-sabot projectiles needed further study. Instead, he proposed that a large caliber naval gun, notably the surplus 355mm guns intended for the delayed *Ersatz Freya* battle cruiser, could have a special 210mm long barrel inserted as a liner, offering a 100km range without the ballistic complications of an unproven discarding-sabot projectile. In the autumn of 1916, Rausenberger proposed this option to Oberst Max Bauer, the artillery section chief of the general staff, who in turn presented it to the supreme commanders Field Marshal Hindenberg and General Ludendorff. The weapon needed the approval of the Reichsmarineamt since it meant taking over guns paid for by the navy. Since the navy was already operating long-range fixed guns in a ground role on the Belgian coast and elsewhere, approval for the "21/35cm kanone" was granted with the understanding that it would be crewed by naval personnel. The development program was dubbed the Wilhelmunternehmen (Wilhelm Project) after the Kaiser, and the gun itself was called the Wilhelm-Geschütz (Wilhelm Gun).

Ballistics trials began in late 1916 along with preliminary gun design. In February 1917, Ludendorff unilaterally changed the range requirement from 100 to 120km due to a decision to pull back the front line northeast of Paris. This seemingly small change in range was a major technical challenge and necessitated increasing the muzzle velocity of the projectile to 1,600m/s compared to the best existing guns that offered about 1,000m/s. This was accomplished by lengthening the barrel from the planned 21m to 24m, and increasing the propellant from 120kg to 200kg. This would create internal pressures of 4,000 atmospheres, when previous guns had only experienced pressures of 3,000 atmospheres. The barrel length was not a trivial issue, since the rifling machines at Krupp had a limit of 18m. The solution was to add a 9m smooth-bore tube at the end of the gun, which involved some significant engineering issues to prevent problems when the projectile passed from the rifled to the smooth-bore section. Another significant challenge was the elasticity of such a long, thin barrel that would naturally droop about 90mm (3.5in.) under the pull of gravity, creating some dangerous ballistics problems. To eliminate barrel droop, Krupp engineers designed a truss for the gun mount that carried steel supports to the forward section of the barrel. A special optical device was inserted into the gun barrel before firing, tension was applied along the supports to straighten the barrel, and once the barrel was perfectly aligned based on the optical instruments, the tensioning was halted and the supports locked in place.

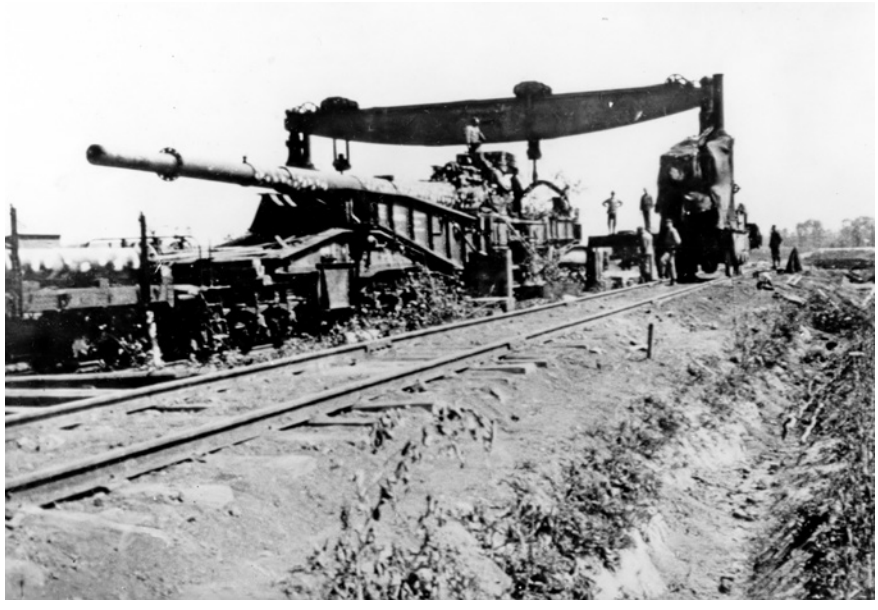
Krupp had already undertaken research into high-altitude projectile performance, but the new gun would propel the projectile to altitudes of over 40km, the highest altitude for a man-made object until the advent of the V-2 missile in World War II. The effects on the gun's range of the lower air density in the stratosphere were not entirely certain. Another challenge was barrel erosion. In a gun of this power, a small amount of the barrel liner was worn away with every shot. If nothing was done to compensate for this loss, future shots would be unpredictable, since a certain amount of propellant gas would escape around the projectile and shorten the gun's maximum range. To compensate for this erosion, Krupp came up with the solution of manufacturing a numbered set of projectiles, with each subsequent projectile slightly greater in diameter than the previous one. The mounting of the new gun presented fewer problems than the gun and ammunition. The existing Bettungsschiessgerüst (fixed firing mount) used with 352mm L/45 guns could be used, since the recoil of the Wilhelm-Geschütz was less.

A view of the Wilhelm-Geschütz being loaded during the initial trials at Altenwalde. The wooden stairs were not a regular feature of the service version of the gun.

The first gun was assembled at the Kriegsmarine proving ground at Altenwalde on the North Sea, firing to the southwest toward the island of Borkum. The initial tests were conducted on July 23–24, 1917. The first shot with a test slug blew off the forward smooth-bore section of the barrel. After replacing the section, tests were continued at shallow angles with actual projectiles. Two shots disappeared and a third shot, expected to travel 76km, traveled less than 56km. The following two shots appear to have disintegrated and fell only 2km in front of the gun. Internal barrel erosion was far worse than predicted. The gun was transferred back to Krupp's range at Meppen, where the gun could be fired into recovery berms. The next set of firing tests revealed that under the extreme pressure inside the gun tube, the copper and brass driving-bands were disintegrating. Driving-bands are the soft metal rings placed on projectiles that become crushed into the rifling of the barrel to prevent propellant gas from escaping around the projectile during its travel down the barrel. To prevent driving-band disintegration, Krupp switched to harder steel bands, and added a copper band behind to compensate for the erosion occurring between shots. The smooth-bore barrel extension was increased to 12m.

A view of one of the Wilhelm-Geschütz in the Krupp factory at Essen.

These improvements proved to be successful when the second set of full-range tests was



The substantial size of the Wilhelm-Geschütz meant that it had to be transported to its firing site in multiple subassemblies and then reassembled on its anchorage. At this stage, the barrel reinforcing system is not fitted. This is one of the three guns in Germany in early 1918 being prepared for shipment to France. The photo suggests that at least one of the guns had dapple camouflage on its barrel.

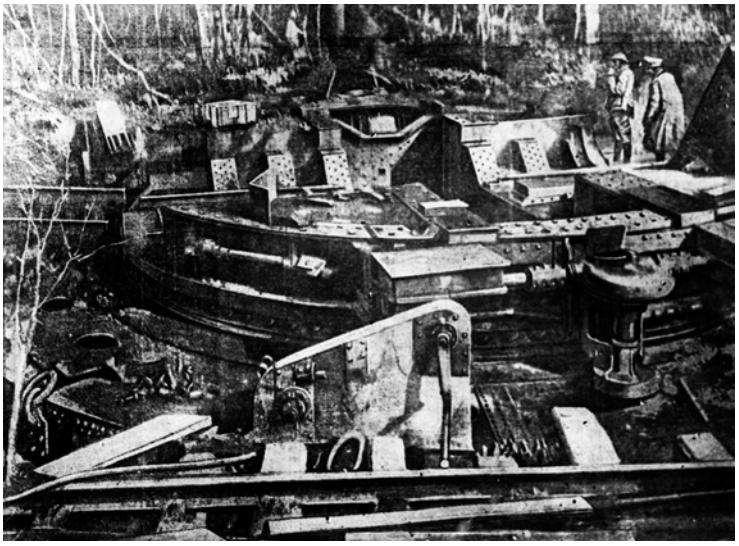
conducted at Altenwalde on November 20, 1917. The test shots quickly reached 100km, and modifications of the propellant charge increased the range to 126km. Upper atmospheric conditions in the stratosphere such as wind were unfavorable during the tests, and the Krupp engineers calculated that the actual range would have been up to 130km under more favorable conditions. The tests concluded in January 1918 and the Wilhelm-Geschütz was judged to be ready for field deployment. The tests were also needed to establish the necessary changes in projectile diameter due to barrel erosion as well as the need to change the propellant to compensate for these factors. The ammunition was produced in sets of 20 sequential rounds, each varying in diameter and charge. Seven barrels were manufactured, since spares would be needed to replace severely eroded barrels. The tests also established the necessary parameters to compensate for atmospheric conditions, the changes in compass settings needed to correct for the earth's curvature at such a range, and the effects of the earth's rotation during the transit time between firing and impact.

The OHL (Oberste Heeresleitung: Army High Command) sent out survey teams in the summer of 1917 and selected a site near Crépy-en-Laon for the initial Wilhelm-Geschütz batteries. Three guns were deployed in the area about 900m apart. To begin site construction, railroad lines were constructed to the battery site to permit the movement of the large gun components. A large concrete foundation was constructed for each gun to accommodate the massive Bettungsschiessgerüst (firing platform). Each was positioned at a known distance from a central point in Paris. The Notre Dame cathedral on the Île de la Cité was the aiming point. Stellung 15 was 119,845m away, Stellung 16 was 119,082m and Stellung 23 was 120,109m. The guns were manned by naval artillery crews, as Fußartillerie Bataillon 1100, under the fire control direction of the head of the Reichsmarineamt, Rear Admiral Maximilian Rogge.

The initial firing was scheduled to coincide with the launch of the Kaiserschlacht, the German spring offensive. The first shot was fired at

0715 hours on March 23, 1918, impacting about 3 minutes later on the Quai de la Seine. At first, Parisians thought that a bomb had been dropped by an unseen Zeppelin or airplane since it was assumed that German forces were much too far away to be using artillery.

Kaiser Willhem personally visited the battery on the afternoon of March 23 to congratulate Rausenberger and the artillery troops. Two guns fired 27 rounds on the first day, with 18 falling inside Paris and four outside; the impact of the others was unknown.



This press photo released in 1918 was long thought to be the only trace of the Paris Gun captured by the Allies in 1918. This Bettungsschiessgerüst anchorage found in the Bois de Châtelet north of Château-Thierry was in fact used by a 380mm gun of Batterie 1015. It was the same type used by the Wilhelm-Geschütz.

It did not take long for the French army to determine that Paris was under bombardment from a gun of exceptional range. By 0900 hours, a team from the Section technique de l'artillerie under Col Jules Challéat had convened and began visiting the impact points to collect surviving bits from the projectiles of the "Paris Kanonen." The impact points offered some clear hints regarding the trajectories of the projectiles, and Spad VII fighters of Escadrille SPA 62 were sent out to locate the German positions. Aerial photos of the suspected sites were taken in the afternoon. In the late afternoon, the army ordered the 78e Régiment d'artillerie lourde armed with 305mm railroad guns to move towards Vailly to begin counter-battery fire.

The battle between the big guns began on March 24. Rausenberger in his diary recalled that, "While we were sitting outside enjoying the lovely spring day and discussing our success, the first French heavy caliber shells exploded with a loud noise some 200 meters from us, sending projectile fragments whistling by our heads. During the third or fourth French salvo, one projectile hit a large tree and exploded overhead, unfortunately wounding six or seven men from the first gun crew." In total, nearly a hundred rounds struck around the three gun batteries, but without causing further injury or damage to the guns. The German army took steps to camouflage the guns, and a number of heavy gun batteries were deployed nearby to mask the firing of the three Paris guns.

B **WILHELM-GESCHÜTZ 21/35cm PARIS GUN (OVERLEAF)**

Technical Data	
Crew	90–91 men
Overall weight	162.7 metric tons
Caliber	209.3mm
Overall barrel length	33.2m (21m rifled + 12m smooth bore; [L/162])
Barrel rifling twist	1 in 35
Projectile weight	106kg
Propellant charge	195.5kg
Initial muzzle velocity	1,667m/s
Max. range	130km

Jim Laurier

One of the Wilhelm-Geschütz deployed to the northeast of Paris in 1918. This provides an interesting view of the truss and metal braces used to support the exceptionally long barrel. (Aberdeen Proving Ground)

In the first series of firings from the Crépy area up to May 1, 1918, the battalion fired 206 rounds at Paris, of which 97 hit the city. Of these, 194 rounds were the basic 209mm projectile and 12 were the enlarged 232mm projectile, necessary due to barrel wear. The gun at Stellung 16 suffered an in-bore detonation in late March 1918 after firing 42 rounds, putting it out of operation. The accuracy of the guns grew progressively worse due to barrel wear. For example, on the first day of firing on March 23, 18 of 27 shots struck Paris (67 percent) but only 13 of 33 the following day (40 percent) and four of 22 (18 percent) on March 25. The barrels were changed on two guns between April 8 and 10 to improve performance.

Due to the initial success of the German spring offensive, two of the guns were moved closer to Paris, to within 90km. Two new positions were created in the Bois-de-Corbie forest near Beaumont-en-Beine. The new Stellung 25 position began firing on May 27, followed the next day by Stellung 15. The closer range permitted the use of smaller propellant loads, which created less barrel erosion. Accuracy continued to deteriorate, however, as detailed on the chart here. A third position was established in the woods near Bruyères for Stellung 32, with 15 rounds fired on July 15 and 16. This position was short-lived due to the advance of the French army, and the remaining guns were withdrawn to the woods near Beaumont after the positions were rebuilt. Stellung 25 fired 66 rounds on Paris in early August before orders arrived on August 10, 1918, to dismantle the gun and withdraw to Crépy.

Wilhelm-Geschütz versus Paris

Location	Dates	Rounds Fired	Impacts in Paris	Percent hitting Paris
Crépy	23 Mar–1 May 1918	206	97	41
Beaumont	27 May–11 Jun 1918	106	34	32
Bruyères	15–16 Jul 1918	15	13	87
Beaumont	5–9 Aug 1918	66	37	56
Total		393	181	46

In total, slightly fewer than 400 rounds were fired by the three Paris guns in 1918; the precise number is not certain. During the 44 days of shelling,

A projectile from the Paris Gun hit the St-Gervais-et-St-Protais Church in the Marais district, east of the Hôtel de Ville, on Good Friday, March 29, 1918, collapsing the roof, and causing 159 casualties. This was the single most deadly incident during the 1918 attacks on Paris. Here, some officers of the American Expeditionary Force visit the church in the autumn of 1918.

256 people were killed and 625 wounded in Paris, and there was widespread damage to many buildings. The heaviest casualties occurred on Good Friday, March 29, 1918, when a projectile hit the St-Gervais-et-St-Protais church during services, collapsing part of the roof, killing 91 and wounding 68 parishioners. This incident inspired the novel *Pierre et Luce* by the Nobel-prize-winning author Romain Rolland. Given the enormous cost of the Wilhelm-Geschütz, its military role remains a technical curiosity rather than a breakthrough in military technology. In total, about 46 tons of projectiles were fired, of which about 21 tons hit Paris. By way of comparison, German air raids on Paris from January to October 1918 totaled about 120 tons or about six times as much. Arguably, the future of long-range firepower rested with the aircraft, not the gun.

The Wilhelm-Geschütz was considered so secret that at the war's end, the remaining guns were scrapped and the barrels melted down; all documentation was ordered destroyed. Rausenberger prepared his memoirs after the war but publication was banned by the German government. When Rausenberger died in 1926, his memoirs disappeared, only to be rediscovered after World War II. They were finally published by the Canadian/American gun designer Gerald Bull in 1988, a figure who we shall meet again in a later section of this book.

In response to the Paris Gun, on March 29, 1918, the French Army established a requirement for a TLP gun (*Très longue portée*: Very Long Range). In May 1918, contracts were given to Schneider and Saint-Chamond to begin development of several different designs. Like the Paris gun, these designs used existing 305mm and 340mm naval guns with a longer 210mm or 240mm tube inserted. The end of the war slowed development, but firing trials of one of the TLP guns at Saint-Pierre-Quiberon in 1929 reached nearly 128km, essentially the same as the Paris gun. These guns remained experimental even though some French officers felt they would be useful to bombard key rail junctions in some future war. One of the technologies explored under the TLP program was a multichamber gun. In 1940, following

One of the contenders for "Supergun of World War II" would certainly be the 800mm K(E) Schwerer Gustav, more popularly called Dora. While its range was not exceptional, it fired an impressive 7.1 metric ton armor-piercing projectile or a 4.3 metric ton high-explosive projectile. It was exceptionally time-consuming to deploy, and its accuracy against Soviet fortifications during the siege of Sevastopol was poor.

the fall of France, the Wehrmacht captured the documentation on the TLP program and the multichamber gun concept, providing the inspiration for the next supergun examined here.

THE V-3 LONDON GUN

After the Great War, the German army retained an interest in a very long-range weapon to strike distant targets, but turned away from guns towards more novel technologies. In 1936, the army approved the development of the A-4 ballistic missile for this mission. The requirements were a one-ton payload and a range of 270km, twice the range and a hundred times the payload of the Paris Gun of World War I.

In the more conventional realm, the German army continued to field a variety of powerful railroad guns and siege guns to deal with targets such as France's Maginot Line. The one aberration from this sober approach was the outlandish 800mm "Dora" railway gun. However, this project was fostered by Hitler, not the army. Its story is told in detail in New Vanguard 231 on "Railway Guns of World War II." This gun fired a 4.8 metric ton projectile to a range of 48km. This offered a similar range to the Great War's 380mm L/45 railway gun, but the projectile was about four times the weight. In June 1942, Dora fired 48 rounds during the siege of Sevastopol, not hitting any of its targets according to Soviet accounts. It was enormously complex to deploy and assemble, and it went into limbo for the duration of the war, as did a partially completed twin.

Germany's other extraordinary World War II supergun was another pet project of Hitler. The Hochdruckpump (High pressure pump), also called the V-3, was a massive multibarrel gun complex intended to bombard London at a rate of about 600 rounds per hour or 20,000 projectiles per month. Not only was its range exceptional, but the London Gun was based on an exotic multichamber configuration.

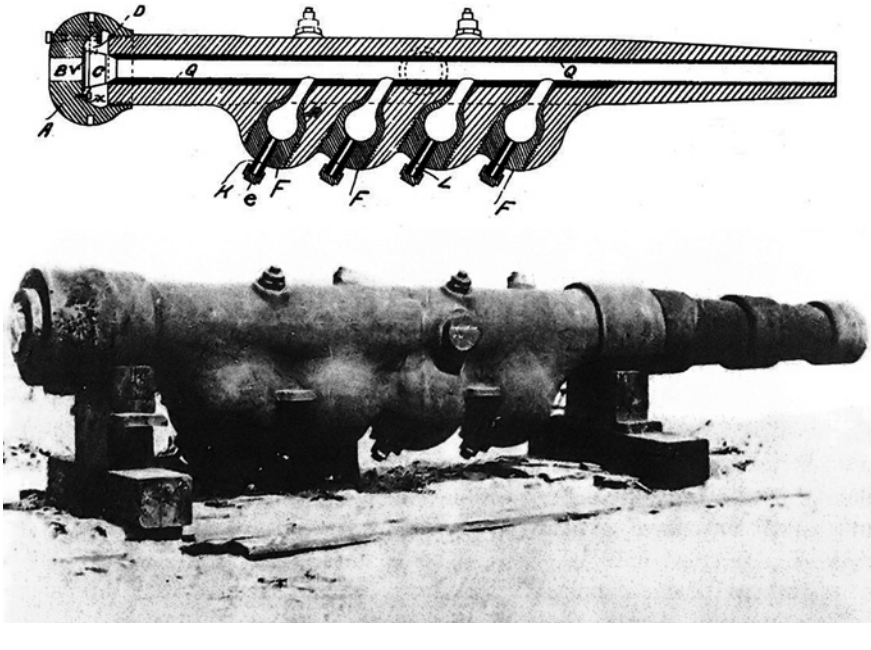
Multichamber guns date back to the mid-19th century. The concept behind a multicharge gun concerns its propellant. In a conventional gun, a single propellant charge detonates all at once, creating a single impulse of energy to propel the projectile. In a multi-chamber gun, there are several propellant charges. After the first charge is ignited, the projectile begins to move down the barrel, followed by sequential detonations of additional charges to impart additional energy. The attraction of this configuration in the mid-19th century was that the wrought iron barrels would burst if subjected to a very powerful single propellant detonation, but they could withstand multiple smaller detonations. Louis-Guillaume Perreaux, a French inventor best known for his role in the invention of the motorcycle, was one of the earliest proponents of such a gun. He received a French patent for his Canon Perreaux in 1864 and he displayed his design at the Paris World Exhibition in 1878. In 1857, the American inventor Azel Lyman received a patent for a multi-chamber gun but the design remained unproven until

the 1880s, when he teamed up with the inventor James R. Haskell.

A Lyman-Haskell 6in. multi-charge gun was constructed and Haskell attempted to interest the US Congress in funding the construction of an 8in. version. He claimed that this 25-ton gun would be more powerful than the Armstrong 100-ton "Monster Gun." The concept seemed promising enough that US Army Ordnance tested the 6in. gun. The tests concluded that its performance was significantly inferior to Haskell's promises. Test firings found that the 6in. multi-charge gun fired a 110lb projectile at 1,935fps (50kg at 590m/s). However, the Krupp 8½in. gun, weighing less than the multi-charge gun, fired a projectile nearly three times the weight at a comparable speed. Further investigations found that the design did not possess adequate obturation, that is, a method to prevent the hot gas from the propellant detonation from leaking in front of the projectile. As a result, the subsidiary charges were actually detonating in front of the projectile, impeding its progress. The Ordnance Department also argued that the configuration of the Lyman-Haskell gun inevitably resulted in a weapon that would weigh substantially more than a modern steel gun. As a result, the Lyman-Haskell gun faded into obscurity even though Haskell developed more refined designs.

One of the largest concentrations of super-heavy artillery in World War II was in the German Atlantic Wall fortifications. These coastal guns were often adaptations of existing naval guns. This is the 406mm SKC/34 gun of Turm Cäsar in a S262 casemate, one of three of the famous Batterie Lindemann of 5./Marine-Artillerie-Abteilung.244 in Sangatte on the Channel coast after its capture by Canadian troops in September 1944. This gun was originally intended for the stillborn "H" class battleships. (National Archives Canada PA-133142)

One of the more curious adaptions of the concept emerged between 1924 and 1926 among a group of German rocket pioneers of the VfR (Verein für Raumschiffahrt: Society for Space Travel). Like many of the early space



The concept behind multi-chamber guns can be traced back to the 19th century. This montage shows the Lyman-Haskell multi-chamber 6in. gun of 1884 with a photo below and the patent drawing above.

August Cönders, the chief engineer of the Röchling, was a controversial figure in German artillery design. He developed a variety of high-speed, subcaliber "arrow" projectiles to penetrate the steel-reinforced concrete armor of fortresses. This is a set of his 210mm Röchling Granate.44 Beobachtungsgeschoss intended for the 210mm Mörser 18. This display by the US Army after the war shows the full projectile on the left, a cutaway in the center, and the discarding sabot at the right, with a US soldier for scale.

enthusiasts, Hermann Oberth and Max Valier had been inspired by Jules Verne's 1865 novel *De la terre à la lune* (From the earth to the moon). In the novel, the space adventurers travel to the moon in a spacecraft launched by an enormous cannon. Valier examined the feasibility of a gun-launched spacecraft in his 1924 book *Der Vorstoss in den Weltenraum– eine technische Moglichkeit* (The Advance into Space – A Technical Possibility), and proposed creating a scale model of a Moon Gun 900m long that would fire a 1,200mm tungsten-steel projectile. This concept had several interesting innovations, including the creation of a vacuum in the barrel to minimize the resistance caused by compression of the air in the barrel in front of the projectile. Valier and Oberth planned to accomplish this by fitting the end of the barrel with a metal cover that would be blown off by the pressure from a small residual amount of air within the barrel. The Moon Gun idea was refined in Vienna in 1928 by VfR members Willy Ley and Baron Guido von Pirquet by changing the gun design to a multi-chamber configuration and fitting a burning propellant at the rear of the projectile, an early version of the "Base-bleed" technology for artillery range extension. This whimsical idea was too expensive to construct without a substantial investment, and it never went beyond a paper design.

The multi-chamber gun concept was revived in Germany during World War II. War-booty French artillery research records from the TLP program mentioned an updated Canon Perreaux, and this concept was discussed at a conference in 1941 between armaments minister Fritz Todt, Generaloberst Friedrich Fromm and the physicist Werner Heisenberger. August Cönders, chief engineer of the Röchling Eisen und Stahlwerke GmbH in Wetzlar, was informed of this configuration and began to consider its potential for a long-range gun to bombard England. Cönders was a familiar figure in German artillery circles since he had been responsible for the design of the so-called "Röchling-geschoss," a specialized high density, long-rod projectile designed to penetrate modern fortresses.

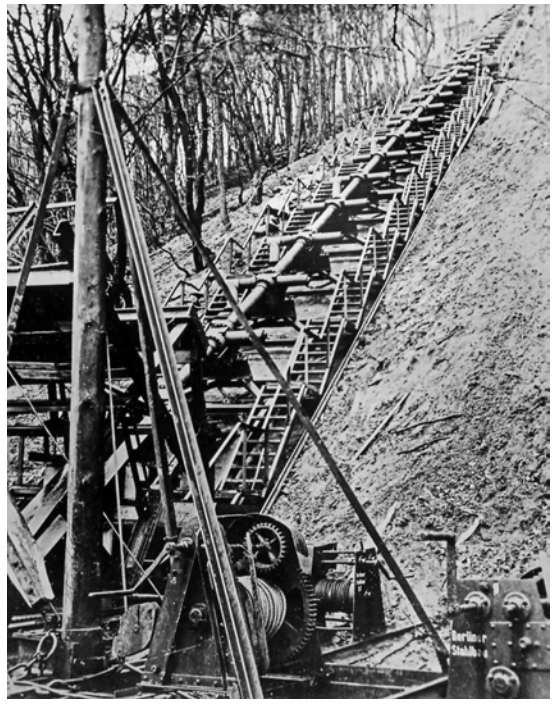
On paper at least, a 100m long, 150mm HDP (Hochdruckpumpe: high pressure pump) would have a muzzle velocity of 2,000m/s and a range of 170km. Each projectile would weigh 140kg with a high-explosive payload of 25kg. Cönders made the bold suggestion that instead of a single gun barrel, a complex of multiple HDP barrels could be mounted together to subject London to a rain of steel and fire. After Todt's death in an airplane crash, Hitler appointed architect Albert Speer to the post of armaments minister in February 1942. Cönders mentioned his HDP concept to Speer later in 1942, hoping to receive government approval to build such a weapon. He constructed a prototype of the HDP using 20mm projectiles, eventually winning Speer's support.

The formal government decision to support the HDP program came in May 1943 when Speer and Hermann Röchling explained the gun during a meeting with Hitler. The Führer was very keen on high-powered artillery;

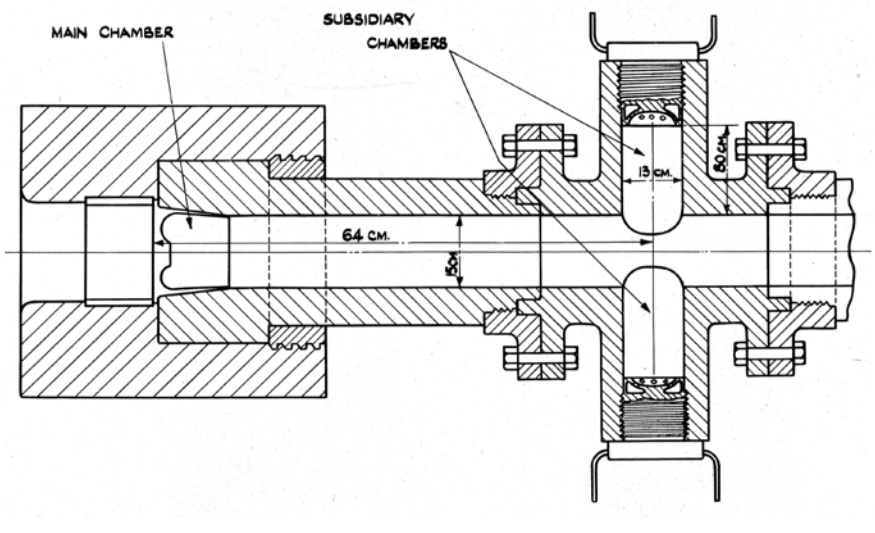
the fact that the HDP promised to have the range to reach London made it all the more enticing. Curiously enough, Röchling requested that development of the gun proceed outside the usual channels, keeping it out of the jurisdiction of the Heereswaffenamt (HWA: Army Ordnance), hinting that previously it had been proposed and rejected.

Hitler's approval for the "England Gun" led to the development of full-scale prototypes of the gun. Two different test establishments were involved. A range was set aside at the main HWA proving ground at Hillersleben. This site was used to test the basic gun design in a horizontal mode, with the projectiles being fired into an earth recovery berm. Once the proof-of-concept device was tested, a second test range was created at Misdroy (now Międzyzdroje, Poland) on the Baltic. The Misdroy site could be used for full-range shots eastward along the Baltic coast.

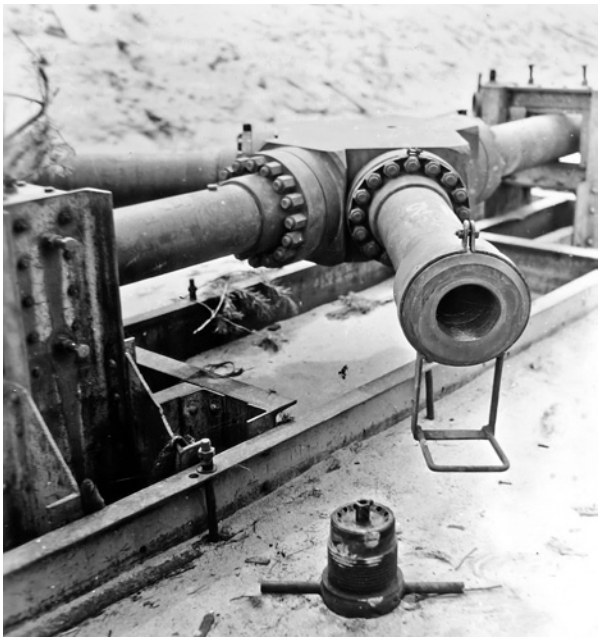
The gun development program was not especially expensive, but the basing mode required a more substantial investment. In order to reach London, a battery site would be located on the Pas-de-Calais, close to the English Channel. The HDP gun batteries were so massive that they would have to be deployed at a fixed site. Such a gun complex located so near to England would be vulnerable to bomber attack, and some form of fortification was essential. A study in early 1943 concluded that a suitable hill with a rock core would be ideal, as the gun tubes could be placed in drifts (inclined tunnels) and the support equipment and supplies located in tunnels adjacent to the firing tunnels. A site was selected at a limestone hill near Mimoyecques. The massive underground structure was codenamed Wiese (Meadow) and Bauvorhaben 711 (Construction Plan 711).



A shortened version of HDP Millipede was constructed on a hill south of Misdroy, aimed out over the Baltic for firing trials. The "Fleissiges Lieschen" (Busy Lizzy) was very similar to this gun, except that it had only 12 sets of subsidiary chambers.



The HDP Millipede had its subsidiary chambers mounted perpendicular to the main chamber, as is seen here in this cross-sectional drawing based on one of the Hillersleben guns.



Each subsidiary chamber was serviced by a screw breech. This example is the test-bed at Hillersleben that had the subsidiary chambers reconfigured at an angle to improve the combustion process.

Initial construction work for support tunnels began in late May 1943, even though the gun concept had not yet been fully proven by full-scale tests. The initial configuration consisted of two gun complexes, each with five drifts, which could each accommodate a stack of five HDP barrels for a total of 50 guns. Due to the substantial amount of work and expense required to complete the Meadow complex, Speer discussed the matter with Hitler during a conference taking place between August 19 and 22, 1943. Speer acknowledged that the HDP gun, now codenamed Tausenfüßler (Millipede), was not yet proven, but that full-scale construction must begin immediately if the gun was to be ready by 1944. Hitler remained enthusiastic about the project, and gave his approval.

As a result, large-scale construction began in September 1943 by the Organization Todt paramilitary construction firm. Two tunnels were carved into the base of the hill to start the process of creating the internal structure. In October, the first shafts began to be excavated from the top of the hill to create the drifts for the guns.

By this point, British intelligence was on full alert for any unusual construction on the Pas-de-Calais due to the discovery of the German missile program based at Peenemünde on the Baltic and the associated missile bases being constructed along the English Channel. Operation *Crossbow*, an air campaign to disrupt the construction of the missile sites, began in the autumn of 1943.[3] Although British intelligence had no detailed knowledge of the role of the Meadow complex, it was soon linked to other "Heavy Crossbow" sites in the area, and put on the target list.

The Meadow complex was bombed by 171 B-26 bombers of the US Ninth Air Force on November 5, 1943, dropping 331 tons of bombs, followed by 48 Mitchell bombers of the British 2nd Tactical Air Force and 29 Typhoon fighter-bombers dropping a further 141 tons. Of these, about ten bombs landed immediately near the tunnel entrances or against other vital points

3 Steven J. Zaloga, *Operation Crossbow 1944: Hunting Hitler's V-weapons*, Osprey Air Campaign 5 (Osprey: Oxford, 2018).

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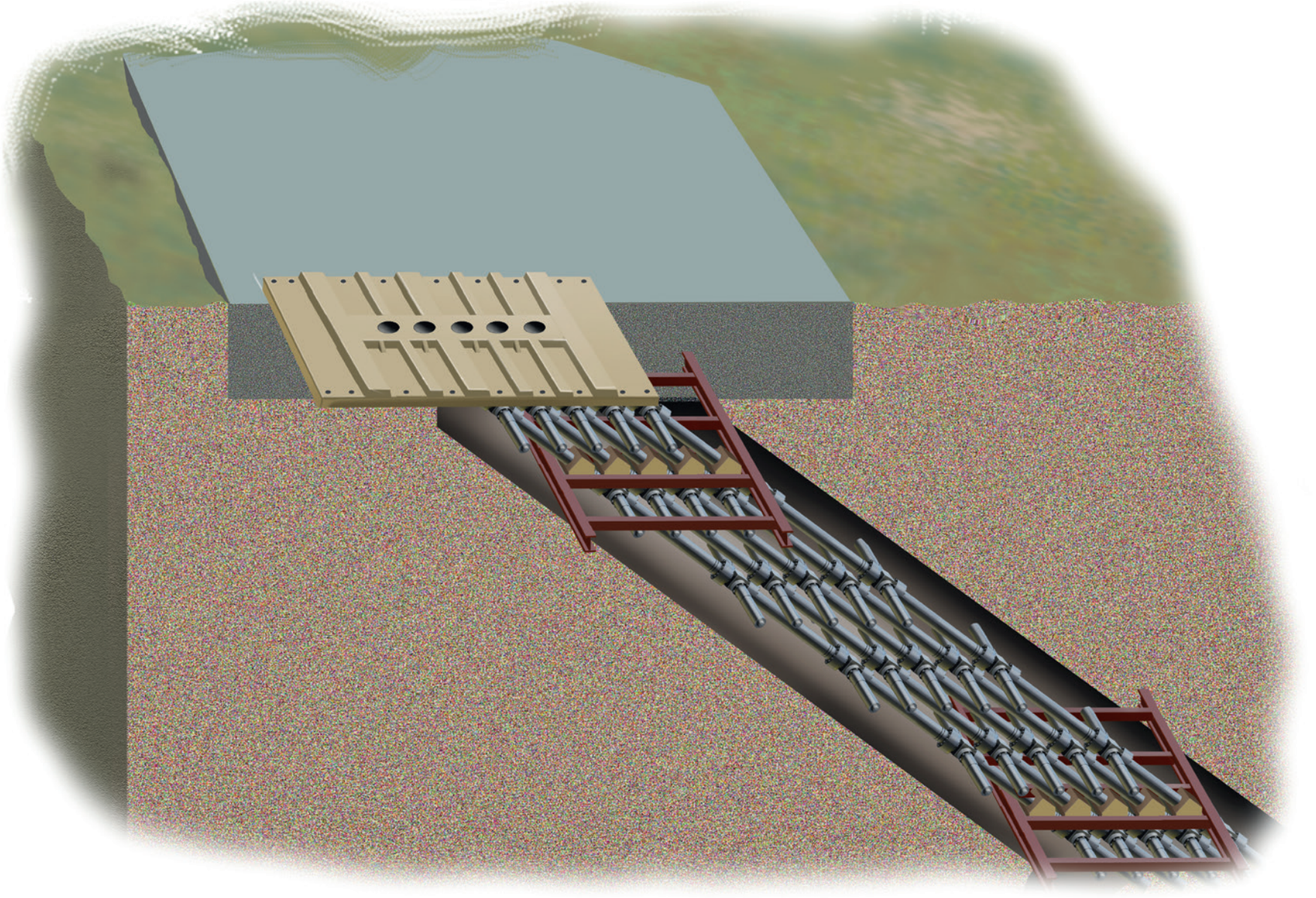
HOCHDRUCKPUMPE TAUSENFÜßLER, MIMOYECQUES, FRANCE, 1944

The HDP Tausenfüßler gun at the Wiese (Meadow) complex in Mimoyecques was mounted in an angled drift cut into the limestone bedrock of a hill. Each gun complex consisted of a set of five barrels stacked on top of one another. Five of these gun complexes constituted a gun battalion and the original plans were for two battalions to be located at the site. There was an elaborate internal structure including stairs and platforms to permit the gun crew to load the 64 subsidiary side chambers of each gun. The gun assembly culminated in an armored cover on top of the hill with the five barrel openings covered by a small, two-piece armored door. Tunnels were excavated into the hill to provide additional supply tunnels to move ammunition, as well as an elevator for supply and crew movement. Each gun complex had a 90-man crew. Although a full 32-section HDP gun was erected at the Misdroy proving ground, the Weise site at Mimoyecques was never finished and no gun was ever erected there.

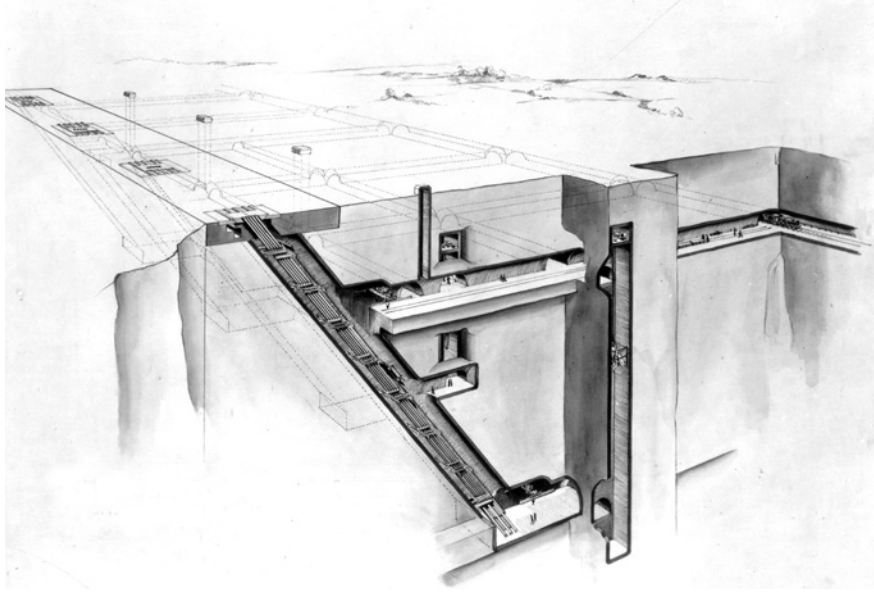


while the rest cratered the hilltop. German casualties were ten dead and 32 wounded in the first attack. This attack was followed on November 8 by 49 Mitchells and 24 Bostons of the 2nd Tactical Air Force dropping 104 tons of bombs, followed by 88 Typhoon fighter-bombers on November 10 dropping 40 tons more. The damage from these three attacks was extensive enough that work on the complex was halted for about a month.

In the wake of the air attacks, Organization Todt decided to scale back the project by halting work on the western battery complex before the shafts were completed, instead concentrating on the eastern battery. The plans were to have the first cluster of five gun tubes ready by March 1944, and a full complex with 25 tubes by October 1 that year. Artillerie Regiment 705 was organized in January 1944 under Oberstleutnant Georg Borttscheller to operate the Meadow gun complex. This unit began training with the test guns at the Misdroy proving ground with plans for deployment to the Meadow complex in February 1944.

Aside from the difficulties at the construction site, the test program proved to be more difficult than expected. A subscale demonstrator was built at Hillersleben in the autumn of 1943 to test the basic ballistics of the system. The original scheme was to ignite each subsidiary charge using electrical detonation. The timing of this proved too complex and it became evident that the subsidiary charges were automatically ignited by the propellant gas as the projectile passed by them. The test-bed gun was 30m in length, consisting of six sections using an ordinary 150mm s.FH.18 field gun breech. The gun was oriented at a shallow angle and the test firings had a range of about 8km. Once the basic firings were completed, the first of three test-beds was assembled on a hill south of Misdroy, angled at 50 degrees. The first of these was a shortened version, while the other two were full length. One of the guns was built in an enlarged 210mm configuration. In addition, Röchling was authorized to begin the manufacture of the first 20,000 rounds of the special ammunition.

The construction of the Millipede barrels was quite simple, consisting of smooth-bore steel tubes with a reinforced lining. The 32 double multi-



The Wiese (Meadow) artillery complex near Mimoyecques was a substantial structure carved into a limestone hill. Two batteries were planned, each with five drifts containing five HDP Millipede guns. In the event, Allied bombing attacks prevented any of the guns from being installed.

Aside from bombing damage, the Mimoyecques site was further demolished by Royal Engineers in May 1945. The site has been partially rehabilitated as a museum and this is the main entrance tunnel.

charge subsidiary charge pockets were oriented perpendicular to the line of fire. The projectile was a subcaliber "arrow" design with a full diameter obturator cup at the base of the projectile, and an additional sabot towards the nose to position the projectile in the tube. The projectile was loaded into the gun via a normal sliding drop breech, with the main propellant charge behind it. Subsidiary charges were loaded into each of the 64 side chambers. Although it was originally presumed that each chamber would have to be electrically detonated, a simpler technique was discovered. When the gun fired, the projectile began moving up the barrel at a medium velocity. As the projectile passed the subsidiary charges, the propellant gas ignited each subsidiary charge in sequence, gradually building up the projectile speed.

The early test-firings at the Misdroy proving ground had mixed results. The initial muzzle velocity was around 1,100m/s, significantly less than the 1,500m/s necessary to reach London. The projectiles showed a tendency to tumble after leaving the tube. An army commission, including the head of the Heereswaffenamt, Gen der Artillerie Emil von Leeb, was convened at Misdroy on March 22 to assess the program. On March 25, 1944, a series of firing demonstrations were conducted at Misdroy for the commission. The German army officers concluded that the Millipede was a useful concept but that the projectile design was faulty and the muzzle velocity needed significant improvement. Gen Erich Schneider, head of the development branch of the Heereswaffenamt, was skeptical whether the problems could be solved. The commission concluded that a second subscale version of the Millipede should be constructed at Hillersleben for further experimental work and that contracts should be issued to several firms to develop improved projectiles. Further manufacture of the initial Röchling projectile was halted.

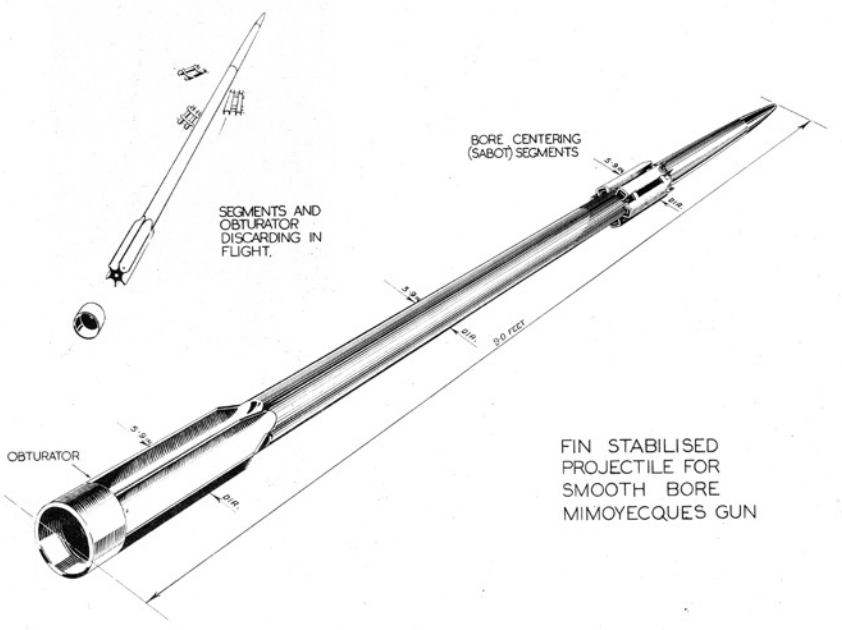
The issue of projectile stability was turned over to the Aerodynamics Research Institute in Göttingen (DFL: Deutsche Forschungsanstalt für Luftfahrt) and tests were conducted in their wind tunnels. Four new projectiles were developed: an improved design from Röchling, and designs from Deutsche Faserstoff, Bochumer Verein and the Witkowitz Eisenwerk. These used a variety of configurations, including pop-out fins to improve

This is a view of one of the two HDP Millipede test-beds after its capture by US troops in 1945. This particular example had ten angled subsidiary chambers and was about 75m (245ft) long.

stability. A total of 29 rounds of the four designs were test fired at Misdroy between May 20 and 24, 1944. The tests indicated that the initial muzzle velocity had been increased to 1,300–1,400m/s, but this was still short of the 1,500m/s needed to strike London. Proposals were made to decrease the payload to only 6kg to boost the range. Krupp offered some suggestions to improve the barrel design, since it appeared that the existing design would not be durable enough to fire 1,000 rounds before needing replacement. The second test-bed gun built at Hillersleben used a revised configuration of the subsidiary charge chambers. Scientists of the RFR concluded that the perpendicular orientation of the chambers caused a loss of some energy due to eddies created during the combustion process, so the revised design used inclined chambers. Improved propellant was also developed, though one type managed to destroy the subsidiary chambers during test firings.

In spite of the slow but steady progress on gun development, the greater problem was Allied bombing of the Meadow complex at Mimoyecques. Allied photo reconnaissance showed renewed construction activity at the site, prompting a new wave of air attacks by the US Eighth Air Force starting on March 19, 1944. Through the end of May, the Meadow complex was hit by nine raids totaling 324 sorties and 935 tons of bombs. The limestone hill proved to be very resistant to the types of bombs employed, but the extensive damage around the site substantially delayed work. Another lingering problem was the presence of natural pockets of groundwater in the hill. In spite of the concrete lining of the drifts, water continued to leak into the structure. The bomb damage at the site, as well as the poor results of the March test firings, prompted Speer's office to recommend scaling back the Meadow complex to only three batteries and reducing the monthly production objectives from Hitler's extravagant demand of 25,000 rounds per month to only 5,000. Hitler acquiesced to these proposals during a meeting on April 6–7, 1944. By the beginning of June, tests at Misdroy of the new projectiles with reduced 6kg payload reached 150km, and some new designs with a 10kg payload seemed promising. Work on the Meadow complex proceeded in spite of the bombing. A report on June 1, 1944 indicated that the first five-tube gun battery would be installed on July 15, the second on August 15 and the third on September 15.

In the event, the Meadow complex never had any Millipede guns installed. The difficulty in penetrating the steel-reinforced concrete roofs of several of the Heavy Crossbow bunkers in the Pas-de-Calais region had led the RAF to sponsor the development of a 12,000lb "earthquake" bomb codenamed


BORE CENTERING (SABOT) SEGMENTS
SEGMENTS AND OBTURATOR DISCARDING IN FLIGHT.
OBTURATOR
FIN STABILISED PROJECTILE FOR SMOOTH BORE MIMOYECQUES GUN

This technical drawing of the 150mm Sprenggranate 4481 projectile was prepared by Allied intelligence after the capture of some ammunition at Hillersleben. As can be seen on the inset drawing, the forward sabot sections and the rear obdurator cup separated from the projectile after it left the gun barrel.

"Tallboy." On July 6, 1944, the 617 Squadron attacked Mimoyecques with 16 Tallboy bombs of which four penetrated into the structure, one of which collapsed one of the three drifts being prepared for the first Millipede gun. A German report indicated that the attack killed nine and wounded 14 others, but later French accounts indicate that a large number of workers, perhaps as many as 2,000, were killed when the bombs disrupted the local water table and flooded the lower level where they were sheltering. The Eighth Air Force staged another attack on the site on August 12, 1944, using a novel remote control bomber as part of the secret Aphrodite program. The plane blew up prematurely, killing the pilot, Lt Joseph P. Kennedy Jr, elder brother of future US president John F. Kennedy.

In view of the extensive damage caused by the Tallboy attack, the Heereswaffenamt sent a team to inspect the site. In late July, they recommended that further work on the Millipede gun at Mimoyecques was pointless due to the extent of the damage and the likelihood that the site would be bombed again if there was any evidence of work to clear the debris. Instead, they recommended that the first Millipede battery be moved to the quarry in Rinxent near the Channel coast. In the event, none of this work ever took place. Mimoyecques was hit by another RAF bomber raid on August 28, 1944, and the site was captured by the Canadian 3rd Infantry Division on September 5. Curiously enough, the British government was concerned that the site might be reconstructed at some future date. On May 9, 1945, a team from the Royal Engineers detonated ten tons of explosives in the tunnels, followed by another 25 tons on May 14 to demolish the remaining structures.

Some 150mm Sprenggranate 4481 projectiles were sent back to the United States, and here one is displayed after the war at Aberdeen Proving Ground, minus its nose fuze.

The sole surviving relic of the HDP gun is this 150mm Sprenggranate 4481 projectile on display at the Musée National d'Histoire Militaire (National Museum of Military History) in Diekirch, Luxembourg. The exhibit example was partly reconstructed due to missing parts.

In spite of the loss of the Meadow site, the saga of the HDP gun continued. By this stage, it had received a new codename, "Fleissiges Lieschen" (Busy Lizzy), and a new sponsor. The Waffen-SS gradually usurped control over all of the V-weapon programs under the command of SS-Obergruppenführer Hans Kammler. The various launch battalions became part of Kammler's Division.zbV (Division zur besonderen Verwendung: Special Purpose Division). To make the HDP more practical, several shorter versions were developed, designated as Langrohrkanone (LRK: Long barrel cannon). Of the four designs, only LRK 15 F 58 was produced in any significant numbers. This version used 12 subsidiary chambers on either side of the tube and was 30m long. This gun had a rate of fire of about two to three shots per hour. Testing of the LRK 15 F 58 took place at Misdroy starting on November 14, 1944. By this stage, the final design of the 150mm Sprenggranate 4481 had been completed and had entered limited production, with 700 rounds promised by the end of 1944. In fact, the pre-series ammunition did not start testing at Hillersleben until December 22, 1944, and the first production rounds were not delivered to the field until December 29. The propellant package was designated as AZ KM 20 and consisted of the basic charge and 24 subsidiary charges. The range could be altered by adjustments to the charge, with a minimum range of 40.4km with the base charge, and a range of about 45km with full increments.

The gun was ready for deployment towards the end of 1944, and so Kammler decided to use it in support of the Ardennes offensive in mid-December. Kammler's plan was to aim one battery at Luxembourg city and one battery at Antwerp. Since Antwerp was already the target for V-1 and V-2 missiles, priority went to Luxembourg city, which was being used by several US Army headquarters. Batterie Nr. 1 of AR.705, commanded by

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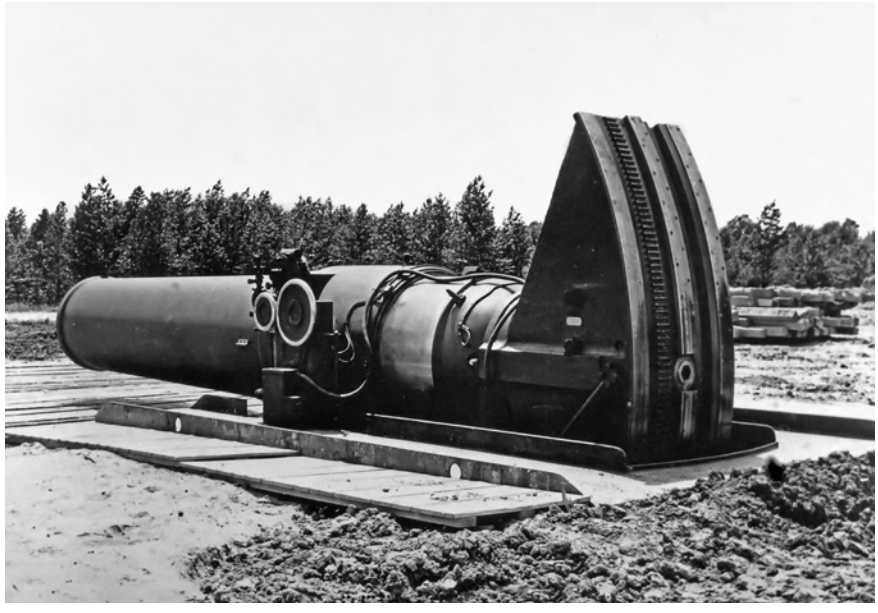
LANGROHRKANONE 15 F 58 FLEISSIGES LIESCHEN, 1.BATTERIE, ARTILLERIE-REGIMENT.705, LAMPADEN, GERMANY, JANUARY 1945

Even though the full Hochdruckpumpe was never completed at Mimoyecques, the Waffen-SS decided to create a smaller 12-segment version of the gun that could be deployed without the elaborate construction needed for the original full-length gun. Two of these guns were erected on a hill near Lampaden in December 1944 to fire against Luxembourg city during the German offensive in the Ardennes in December 1944. A shortage of ammunition delayed the initial firing until late in December. The LRK 15 F 58 version of the gun was about 50m long (165ft) and weighed about 28 metric tons when deployed. It had 12 sets of subsidiary chambers, for a total of 24 subsidiary breeches. The 150mm Sprenggranate 4481 projectile was loaded into a conventional sliding gun breech at the base of the gun, along with its primary charge. As the projectile passed by the subsidiary chambers, the heat of the propellant gas ignited each subsequent auxiliary propellant charge, accelerating the projectile. The LRK 15 F 58 had very little additional support equipment except for a single rail track on the right side that was used for a crane in the assembly of the gun and for moving small carts with subsidiary charges up the hill. The nominal rate of fire for the gun was two to three rounds per hour, though this was seldom obtained in practice.



One of the most extreme weapons of World War II was the T21 36in. (914mm) Little David. In spite of its large caliber, its actual performance statistics were less impressive, firing a 3,650lb projectile a distance of 6 miles (1,655kg to 9.7km). It was intended for siege warfare during the anticipated invasion of Japan in 1945.

Hauptmann Patzig, deployed two LRK on a hill south of Lampaden along the Ruwer river, 43.5km from Luxembourg city. The first gun was in place by December 28, and the first 44 rounds of ammunition arrived on December 29. The first gun began firing at 23:16 hours on December 30. The second gun came from the Misdroy proving ground and began firing on January 4, 1945, once more ammunition arrived. Ammunition was in very short supply in spite of SS demands for 5,000 rounds. The plan was to deploy at least three batteries, each with two guns. The 2./AR.705 with two more guns was deployed to Alsace to support the Operation *Nordwind* offensive. One gun was assembled near Buhl, but the defeat of *Nordwind* led to a recall of the two guns before they fired any shots in anger. The ammunition supply completely dried up in February 1945 and the final shots were fired from the Lampaden area on February 22. In total, 183 rounds were fired, killing ten and wounding 35 in Luxembourg. The only known military damage caused by the gun occurred on January 12 when a US Army mobile laundry unit was hit, wounding seven soldiers and damaging three vehicles. The four guns were disassembled and moved to the Röchling plant in Wetzlar, where they disappeared. An Allied intelligence team that visited the factory after the war did not mention finding them in their report, but they may very well have been overlooked. The two test guns at Hillersleben were discovered by US Army teams and parts of at least one of these were disassembled and shipped back to Aberdeen Proving Ground along with a few projectiles. There is no evidence that the Red Army captured any surviving examples at Misdroy.

The British sent a team under Maj Robert Turp to investigate the HDP gun program. Years later, Turp was interviewed for several days about the gun by a Canadian engineer, Gerald Bull. As we shall see, Bull's interest in the Paris Gun and the HDP would become manifest decades later in the Project Babylon supergun.

Although the HDP guns were the longest-range cannon of World War II, other weapons had a larger bore. The T21 36in. (914mm) Little David mortar is worth mentioning. This device was developed at Aberdeen

Proving Ground to test aircraft bombs without the need for a test aircraft. It was suggested that it could be converted into a siege mortar for use in the expected invasion of Japan, so in 1945 the device was made semi-mobile. It could be towed into position, but required the excavation of an emplacement for its fixed anchorage. It could fire a 3,650lb projectile a distance of 6 miles (1,655kg to 9.7km), so its performance was far from "super" in terms of firepower or range. One other curious feature of this weapon was that it was muzzle-loaded using a small crane. In the event, the war ended before the Little David was put into production. This was not the last of the huge bomb throwers, however. The Red Army captured elements of the German 800mm K(E) and studied it as the possible basis for a future artillery piece. They recognized that it was too cumbersome to be practical, but work was undertaken at the Barrikady plant in Stalingrad on Project BR-105, a huge 650mm cannon to test-fire 1,500kg and 3,000kg bombs. This device was never manufactured, but it did inspire Soviet super-heavy artillery designs well into the 1960s.

THE BIGGEST BOOM

Interest in very long-range artillery waned after World War II, since this mission could be more efficiently accomplished by missiles or aircraft. Nevertheless, early missiles were expensive and unreliable. Artillery still offered 24-hour responsiveness in all weather conditions while being much more economical than missiles for most firepower missions. The most extreme artillery weapons of the Cold War years were characterized by their firepower rather than range due to the advent of miniaturized nuclear warheads.

The first successful artillery-fired nuclear device was the US Army's W-9 280mm projectile. Development of this warhead and its associated gun began in 1950 as a stop-gap until tactical nuclear missiles became available. The US Army had been considering a new weapon to replace the towed 8in. gun/240mm howitzer Black Dragon family since 1944 due to the prolonged time required to emplace these weapons. The new 280mm gun

An Atomic Annie M65 280mm heavy motorized gun on display at Aberdeen Proving Ground in September 1952 with the gun separated from its transporters. Its nickname stemmed from the influence of the German K5(E) "Anzio Annie" railway gun in its development.

A view of the M65 Atomic Annie in transport mode at Aberdeen Proving Ground in 1952. In travel mode, the system used the M249 Heavy Gun-Lifting Front Truck and M250 Heavy Gun-Lifting Rear Truck.

was heavily influenced by the design of the German 280mm K5(E) railroad gun and the recoil system of the German 170mm gun. Instead of a railway configuration, the M65 280mm gun was suspended between tandem M249/M250 transporter trucks. This gun was most commonly called the "Atomic Cannon," or "Atomic Annie." The later nickname stemmed from the fact that the gun was developed at Aberdeen Proving Ground where a captured German K5 (E) called "Anzio Annie" was on display. The German gun was captured during the fighting around Anzio, hence its nickname.

Deliveries of the M65 gun and the associated W-9 nuclear projectile began in 1952, and eventually 20 of these gun systems were manufactured. The first test of the system took place on May 25, 1953, as part of the Operation *Upshot/Knothole* trials, when a single W-9 was fired from a M65, detonating at an altitude of 524ft at a range of 7 miles with an explosive yield of 15 kilotons. The 800lb (365kg) W-9 nuclear projectile was short-lived and replaced in 1957 with the lighter 600lb (270kg) Mk 19 projectile, which extended the range. With the advent of tactical ballistic missiles with much better range, the M65 280mm gun was withdrawn from service in 1963.

The Soviet Union began work on artillery-fired nuclear artillery in 1954 with a "triplet" program: the 2A3 Kondensator 406mm gun, the 2B1 Oka 420mm breech-loaded mortar, and the 420mm S-103 recoilless rifle. The three weapons were designed by different artillery design bureaus, but all three were based on tracked chassis developed at the Leningrad Kirov Plant using components of the T-10 heavy tank. The S-103 recoilless rifle project fell by the wayside in November 1956 when its barrel disintegrated on its 93rd test firing.

The other two weapons each had two different nuclear projectiles, the Kondensator-AR and -D for the 406mm gun, and the Transformator-AR and

E

M65 GUN, HEAVY, MOTORIZED, 280mm "ATOMIC ANNIE"

The most powerful field gun ever built was the M65 280mm gun. The cannon itself was not especially distinctive in its basic design, though the use of twin prime movers was novel. This weapon's main claim to fame was the power of its projectile, the W-9 15 kiloton atomic projectile. The one and only live firing of this weapon took place on May 25, 1953, near Frenchman Flat at the Nevada Test Site as part of the Operation *Upshot/Knothole* trials. A W-9 was fired from a M65, detonating at an altitude of 524ft at a range of 7 miles with an explosive yield of 15 kilotons. The M65 gun was finished in the usual US Army olive drab, though a portion of the barrel that recoiled into the recuperator was left in bare steel.

One of the 2A3 Kondensator-2P 406mm guns has been preserved at the Central Armed Forces Museum in Moscow. Its SM-54 gun proved to be so powerful that the entire chassis recoiled several meters every time it fired.

-D for the mortar. These alternatives presumably used different nuclear physics packages. The Kondensator 420mm projectile was based on the RDS-41 physics package, first tested in March 1956. It weighed 580kg, had a yield of 14 kilotons, and a maximum range of 25.6km. The Transformator 420mm mortar round used a nuclear physics package derived from the RDS-9 nuclear torpedo warhead, weighed 650kg, and had a maximum range of 25km.

In the event, four of each of the Kondensator-2P and Oka were manufactured. They debuted in the Moscow Red Square parades in November 1957 before testing had been completed. At this time, their nuclear projectiles were not fully ready for service use. Following Stalin's death in 1953, Nikita Khrushchev gradually took over central power. Khrushchev favored the new generation of nuclear missiles and had a strong aversion to traditional heavy artillery as epitomized by the lumbering Oka and Kondensator. Neither had performed well in their original army trials. The vehicles were extremely difficult to transport since they were too wide for many bridges or for the Soviet railway system. In addition, the exceptionally long barrels posed many transportation issues. The recoil of the Kondensator was so great that the entire vehicle was pushed back several meters when it fired. The Oka was designed to be fired with the barrel at a high elevation. While this did not cause the extreme recoil problems of its stablemate, it placed enormous stress on the vehicle chassis in spite of the provision of reinforced shock absorbers. Even without Khrushchev's vociferous opposition, both weapons probably would have been rejected for army use due

The 2A3 Kondensator-2P traveled with its huge gun tube pointing over the rear of the vehicle. The driver's cab was on the forward right corner of the Obiekt 271 chassis, as seen here. It had a top road speed of 30km/h and it weighed 64 metric tonnes.

to these technical issues. In the event, both were canceled in 1960 before ever actually being put into regular army service. Instead, the Soviet Army relied on a new generation of tactical ballistic missiles including the Mars/Luna (FROG) series and the R-11/R-17 (Scud) for tactical nuclear weapons delivery.

A second generation of Soviet nuclear artillery projectiles was started in 1964 after Khrushchev's ousting. By this time, nuclear projectiles had been reduced in size by a considerable margin, and so the projectiles could be fired from existing artillery systems. This generation included the 203mm 3BV2, 152mm 3BV3, and 240mm 3BV4 projectiles, and entered service later in the decade. The 3BV3 152mm nuclear projectile was reported to have a yield of 2.5 kilotons, but data on Soviet tactical nuclear warheads remains sparse. A third generation of Soviet tactical nuclear projectiles was fielded in the 1980s but data on these remains classified.

A single 2B1 Oka 420mm self-propelled mortar has been preserved at the Central Artillery and Engineer Museum in St Petersburg. The Transformator nuclear projectile can be seen displayed below the mortar tube.

Nuclear artillery projectiles were widely deployed through the Cold War years, with newer types gradually emerging due to improvements in nuclear warhead miniaturization. In general, the yields of later US Army nuclear projectiles fell considerably in the 1960s, since the 15 kiloton yield of the original W-9 was viewed as wildly excessive for battlefield tactics. Deeper targets requiring larger warheads were the mission of tactical ballistic missiles. More typical yields of US nuclear artillery projectiles during the 1960s and 1970s were in the neighborhood of 0.1–0.25 kiloton (100–250 tons HE equivalent). To put this in some perspective, even the smallest of these projectiles had a high-explosive yield more than 100 times greater than the largest land-based gun of World War II, the German "Dora" 800mm railway gun that fired a 4.6 metric ton projectile with a 700kg high-explosive payload.

The Obiekt 273 chassis of the 2B1 Oka was based on T-10 heavy tank components, but the rear suspension was substantially reinforced due to the recoil of the mortar when fired at high elevation. The mortar pointed over the rear of the vehicle, and this view shows the front with its driver cab. The Oka weighed 55 metric tonnes.

The 2S7 Pion was developed in the 1970s for heavy artillery brigades to deliver nuclear and conventional firepower. It was armed with the 2A44 203mm gun capable of firing the 3BV2 nuclear projectile to a maximum range of 35km and conventional rocket-assisted rounds to 43km. This is an upgraded 2S7M Malka at the Alabino proving ground outside Moscow in 2017.

Aside from a handful of these superguns, field artillery of the Cold War years was largely devoid of the extravagant giganticism of the two world wars. This was due to two major factors. To begin with, artillery technology by this era was very mature and there were very few technological breakthroughs aside from nuclear projectiles. Incremental improvements in projectiles and gun designs continued, but the artillery pieces of 1990 would have been very familiar to a gunner from 1918 or 1945. Secondly, aircraft and missiles largely took over the long-range bombardment mission. While a 4-ton projectile as fired by the German 800mm "Dora" railway gun was at the extreme end of artillery payloads, it was an ordinary payload for bombers or tactical ballistic missiles.

PROJECT BABYLON SUPERGUN

By the 1960s, missiles and attack aircraft had begun to take over the long-range bombardment role from conventional artillery. There were a few exceptions, with the superguns of Gerald Bull being the most extreme example.

F

1: 420mm S-103 RECOILLESS RIFLE

The S-103 420mm recoilless rifle was developed by the famous Soviet gun designer V. G. Grabin, while the tracked chassis was developed by the Leningrad Kirov plant (LKZ). The recoilless rifle failed on its 96th test firing on November 29, 1956, and the program was subsequently canceled before any series production was undertaken.

2: 406mm 2A3 KONDENSATOR-2P SELF-PROPELLED GUN

The 406mm SM-54 gun was developed under the direction of I. I. Ivanov of the Central Design Bureau 34 (TsKB-34) as part of the 2A3 Kondensator-2P self-propelled gun. The Obiekt 271 chassis was developed by the Leningrad Kirov plant based on components from the T-10 heavy tank. The first example of the system was completed in Leningrad on December 26, 1956, with a total of four eventually completed. It had an overall weight of 55 metric tons and was powered by a 750hp diesel engine with a maximum road speed of 30km/h. These were finished in the usual Soviet army camouflage green color.

1

2

This is the 16.7in. (424mm) L/86 HARP gun located at the Yuma Proving Ground. This was based on surplus 16in. battleship gun tubes with a barrel extension added. (US Army)

As a young doctoral candidate in aerodynamics, Bull went to work for CARDE, the Canadian Armament and Research Development Establishment, in the mid-1950s. Bull specialized in supersonic wind tunnels for research, and was also involved in pioneering attempts to use artillery to accelerate subscale models for missile development. After receiving a teaching post at McGill University, Bull began to promote the idea of using large-caliber guns as an inexpensive alternative to rockets to conduct high-altitude research. Although the development work began in Canada, funds were very limited. In 1961, Bull convinced the US Army to support this effort, and he began a long collaboration with Dr Charles Murphy at Aberdeen Proving Ground. Bull's gun concept became the heart of Project HARP (High Altitude Research Program), which Bull later described in a report:

> HARP is directed toward the use of guns for scientific probing of the upper atmosphere. The attractive features of guns for this purpose are the basic economy of such a system and the high inherent accuracy of guns for placements at altitude as well as accuracy in ground impact. The basic liability for such an approach lies in the very high accelerations experienced by gun-launched payloads. The guns used in Project HARP vary in size from 5-inch and 7-inch (175mm) extended guns on mobile mounts to transportable fixed 16-inch guns. Altitude performance varies from 20 pound, 5-inch projectiles reaching 240,000 feet to 185 pound, 16-inch projectiles reaching 470,000 feet … Scientific results to date are primarily wind profiles … Sun sensors, magnetometers and temperature sensors have been flown.

Bull installed the first test guns on Barbados in the Caribbean in 1962. Work on this concept sparked Bull and Murphy's interest in the Paris Gun. One of the technical issues that was particularly valuable to Project HARP was the manner in which Rausenberger had overcome problems created by the joint between the rifled portion of the Paris Gun barrel and the final smooth-bore section. This was a significant issue since the HARP guns were in most cases repurposed guns with extended barrels. Bull and Murphy later turned their pioneering work on the Paris Gun into a book, which remains the most detailed technical account of the Paris Gun to date (see bibliography for more details).

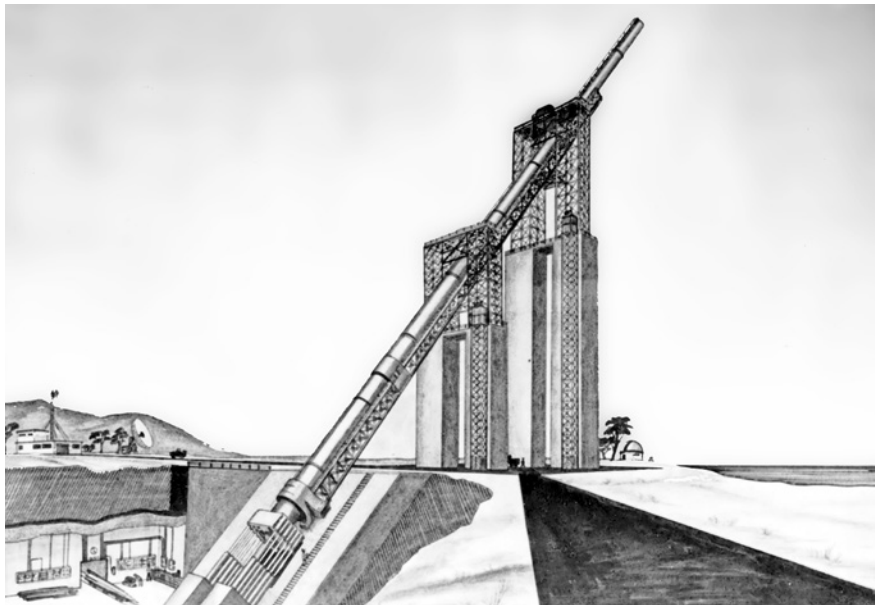
The HARP experiments eventually used a family of subcaliber projectiles called Martlet's that continued to evolve in size and sophistication. Unlike

artillery projectiles, these housed small scientific sensors or were used for depositing chaff or other substances in the upper atmosphere for research purposes. Bull and Murphy worked on other innovations as well, including a multi-point propellant ignition system that had some of the advantages of the HDP's multi-charge concept without the drawbacks of the multiple chambers. Multi-point ignition detonates the propellant charges in sequence rather than simultaneously. Besides the gun-launchers installed on Barbados, additional gun-launchers were installed at the US Army's Yuma Proving Ground. In total, more than a thousand firings were conducted. The Martlet 3 project encompassed work on rocket-boosted projectiles and reached an altitude of 155 miles (250km). Bull's ultimate objective was to demonstrate Martlet 4, a gun-launched rocket-boosted projectile that could put a small satellite into orbit. The Canadian government gradually withdrew its funding from HARP, however, and by 1967, US Army interest sputtered out as well. From a technical standpoint, gun-launched devices were very prone to failure due to the extremely high accelerations of the launch compared to conventional rocket launch.

Bull continued to promote the concept of using guns for space-launch of small satellites, but without government funding, his attention turned in other directions. He created the Space Research Corporation (SRC) and began to develop methods of improving the long-range performance of conventional artillery. He designed the Extended Range, Full Bore (ERFB) projectile and also promoted base-bleed range extension technology after buying up some Swedish patent rights. He eventually moved into long-range artillery design with his GC 45 155mm gun, which combined his projectile innovations with a longer barrel than the existing US 155mm L/39 howitzer. The GC 45 eventually attracted the attention of the South African Army. During conflicts with Angola, the South Africans had found that their old British 4.5in. guns were out-ranged by Soviet 130mm guns employed by the Angolan and Cuban armies. The South African firm Armscor eventually built a derivative of this gun as the G5, and in self-propelled form as the G6. Bull was disenchanted with his arrangements with Armscor and later dismissed the G5 as "a shoddy copy of my weapon." The G5 was used in combat against Angolan and Cuban forces in the 1970 wars. By this stage, Bull had become an American citizen, and his work with South Africa eventually ran afoul of US export laws with the apartheid regime. He was fined and given a short federal prison sentence by the US government.

Disenchanted with his treatment, Bull left for Europe and based his development efforts out of Belgium. His later consulting

This display at the Yuma Proving Ground shows the 16.7in. HARP gun in the foreground and the 5in. L/70 gun behind it at full elevation. The HARP project tested several different calibers of guns for various applications. (US Army)



Gerald Bull's work on Project HARP provides a strong hint of the eventual Iraqi Super Gun. This is Bull's 1966 proposal for a 32in. (815mm) gun launcher for Project HARP. The configuration of the gun and its recoil system is a forerunner to the Project Babylon design.

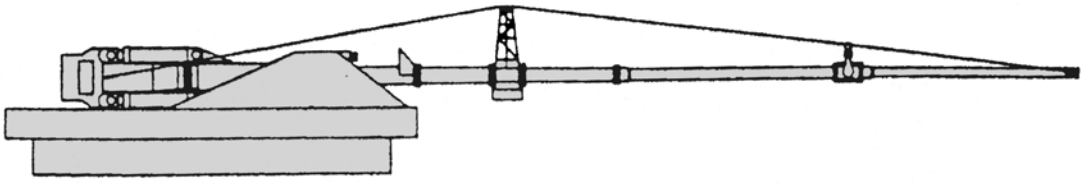
included work in China on long-range artillery. There is some evidence that one of his projects in China was a long-range supergun, but details are lacking.

His next major client was Iraq, which had found that its existing artillery force was inadequate in the war with Iran. Bull developed the 155mm Al-Majnoon self-propelled gun based on the G6 and the enlarged 250mm Al-Fao. These were publicly displayed at an arms show in Baghdad in 1989. Bull continued to promote his idea of a gun-launched satellite, which at least on the surface was the rationale behind Iraq's Project Babylon. Bull set up the separate Advanced Technology Institute (ATI) in Athens, Greece, to manage the program. The ultimate goal of the program appears to have been to develop an extremely long-range gun to bombard Iran and Israel, though Bull continued to insist that the goal of the program was space research. The Iraqi side of the venture was managed by Lt Gen Saadi's State Organization for Technical Industries (SOTI).

The System 350 prototype gun was eventually mounted on a hill in the Jabal Hamrayn mountain range, oriented towards Israel. This configuration is very reminiscent of the mounting of the German HDP guns at Misdroy and Lampaden in 1944 and 1945. It is seen here shortly before being dismantled by the UNSCOM (United Nations).

Project Babylon's principal goal was the System 1000, a 1,000mm L/150 fixed-site gun capable of firing guided projectiles. The similarities to Germany's HDP gun are not coincidental. Bull's gun used multi-point propellant ignition, not a multi-chamber design. As mentioned earlier, Bull had studied the HDP gun, and while not convinced of its multi-chamber configuration, he did appreciate other aspects of its design.

As a stepping stone towards the ultimate weapon, Bull and ATI developed a subscale 350mm version of the gun on a horizontal mount for



This is a CIA illustration of the proposed System 600 gun, which offered elevation and traverse through the use of a turntable. The reinforcement truss over the gun is reminiscent of the Paris Gun, reflecting Bull's long study of early long-range guns.

internal ballistics testing, sometimes called System 350H. The first test-bed was assembled near Sinjar on the Syrian frontier, consisting of the breech and 5m of the gun tube to evaluate the propellant. This was followed by the construction of the full-length System 350H, which was mounted on railroad bogies. This configuration was chosen since the bogies also acted as an improvised recoil system and permitted a rapid disassembly of the gun to examine barrel wear. A total of 11 test firings were conducted, using both slugs and prototypes of a discarding-sabot projectile. After this test-bed had been demonstrated, it was moved to a new site in the Jabal Hamrayn mountain range southwest of Kirkuk in northwestern Iraq and installed at an elevation of 45 degrees on a hill. The gun was oriented to fire into the Iraqi desert, but its azimuth also would have permitted firing into Israel once the full range was obtained. The actual range of the System 350 is not certain, since it was never fired from its hill location.

System 350 was constructed of 26 separate sections, somewhat reminiscent of the HDP. The large number of segments was not really needed for the test-bed, but was undertaken as a means to prove the concept for the full-scale System 1000. A bore liner was fitted inside each tube section with separate seals between each to prevent propellant escape. The barrel was suspended on seven slide supports to accommodate the recoil. The recoil was managed by a foundation-mounted hydraulic system. Although the original design for System 350 was an interrupted screw breechblock, the actual test-bed used a split sliding wedge. The initial ammunition type for the System 350 was the S32, a discarding-sabot, fin-stabilized projectile. This would have evolved into true combat projectiles such as the S43 and S44, which introduced high-explosive payloads. The S44 weighed 135kg with a 15kg high-explosive payload and a maximum range of 265 miles (425km), nearly three times the range of the HDP. There were also plans for the rocket-boosted G36 projectile and various types of guided projectiles, none of which was ever assembled.

Forty-four of the 52 barrel sections for the System 1000 Super Gun had been delivered to the Iskandariyah Motor Vehicle Plant by the spring of 1990. They are seen here on August 13, 1991, during a preliminary visit by an UNSCOM disarmament team. (United Nations)

Besides the test-bed System 350 gun discovered at Jabal Hamrayn, six additional 350mm barrel sections were discovered by UNSCOM at Iskandariyah. One of the larger System 1000 tubes can be seen in the background to the left. (United Nations)

The System 350 used a six-increment bag propellant charge with a stub case for obturation. The propellant used the multi-charge concept pioneered in the Project HARP gun, with spacers between the bag charges.

While test work continued on the System 350, the initial work began on the System 1000 test-bed at the Al Mussayib proving ground. Components for this weapon had been purchased abroad under the disguise of being sections of piping for the Iraqi oil industry. All but eight of the 52 sections of gun-tube had been delivered to Iskandariyah Motor Vehicle Plant by March 1990, but this gun was never assembled. Had the System 1000 actually been built, its basic projectile was the S46, which was intended to carry a 500lb high-explosive payload to a 700km range.

A further derivative of the System 350 was developed to provide limited elevation and traverse as the System 350ET (elevation and traverse). This system also introduced a rocket-propelled projectile that permitted the use of a shorter and more convenient gun barrel. The prototype was in the process of being assembled at Sinjar in 1990. This also served as a test-bed for a proposed System 600 weapon that consisted of a 60m long, 600mm gun with traverse and elevation. Project Babylon 2, which was also under way in 1990, aimed at developing a guided projectile for the various long-range guns. Several concepts were being studied, including a beam-riding guidance system for course correction during the initial period of flight as well as possible terminal homing systems. This aspect of the program was the furthest from fruition in 1990.

Project Babylon existed in a murky world of half-truths and deliberate falsification. Models of the Project Babylon gun were publicly shown at the 1989 Baghdad arms show but identified as a space launch system. Bull himself publicly discussed Project Babylon but insisted that it was simply an extension of his earlier work on Project HARP for space research. Bull was apparently warned on more than one occasion that his work was viewed with alarm in Israel.

Progress on Project Babylon ground to a halt in 1990. On March 22, 1990, Gerald Bull was shot near his apartment in Brussels. It was widely reported that the

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PROJECT BABYLON SYSTEM 350 L/150 GUN, JABAL HAMRAYN , IRAQ, 1990

Gerald Bull's Project Babylon guns never reached the final stage of development. A subscale 350mm version of the gun was mounted on the side of a mountain in Jabal Hamrayn in March 1990 to demonstrate the basic concept. So far as is known, the gun was never actually fired from this location due to Bull's assassination before its completion. The mounting was quite elementary, with a set of concrete foundations for the mounting along with wooden structures including stairways, somewhat reminiscent of the German HDP gun. Much of the gun was covered with tarps and simple wooden roofs, in large measure to shield the work crew from the desert conditions.

These are the massive hydraulic recoil cylinders of the System 1000 Super Gun found by the UNSCOM teams in Iskandariyah, Iraq, in August 1991. (United Nations)

Israeli Mossad intelligence organization was behind Bull's assassination, due to his work on Project Babylon and related work on Iraqi missile programs. British customs began a program to interdict shipments of major components that had been purchased from British firms. The program completely ended in the wake of the February 1991 Gulf War. On April 3, 1991, the UN Security Council passed a ceasefire agreement to formally end the war. The resolution included provisions for the dismantling of Iraqi long-range missile programs, also encompassing Project Babylon. The existing Project Babylon test-bed guns were dismantled under the supervision of UNSCOM (UN Special Commission) and the components for System 1000 were also eliminated.

Questions linger as to why Iraq pursued Project Babylon. Even if the gun system proved feasible, its fixed site location made it very vulnerable to counter-attack. In addition, the payload of its projectile was miniscule given the weight of propellant and size of the gun. Questions have been raised whether the ultimate objective of the program was to fire non-conventional munitions such as chemical warheads, since its effectiveness firing conventional high-explosive projectiles was so modest. Bull had promoted the long-range gun as a cheap alternative to missiles, claiming he could build it for $10 million. By the time the program ended, the program had already cost about $20 million and the Iraqis were increasingly dissatisfied with the slow pace of the work. Like Hitler, Saddam Hussein was prone to technological escapism, frequently becoming obsessed with super-weapons as a panacea.

THE FUTURE OF SUPERGUNS

Most of the superguns examined here were on the bleeding edge of technology. A common theme running through three of these guns, the Paris Gun, London Gun, and Project Babylon, was the quest for long range. These programs were ultimately unsuccessful for two principal reasons. To obtain such long ranges, the size of the projectile and its payload was reduced to the point that the battlefield value of the gun became negligible. Secondly, these guns were created at a time when other emerging technologies, namely aircraft and missiles, offered a more plausible means to conduct the long-range firepower mission. Field artillery remains viable at shorter ranges, however, since it is more economical than missiles and aircraft for most missions. Compared to aircraft, it offers immediate, 24-hour responsiveness to the fire-support demands of the army.

Novel technologies still beckon. At the moment, the most futuristic is the electro-magnetic railgun (EMRG). Instead of using chemical propellants,

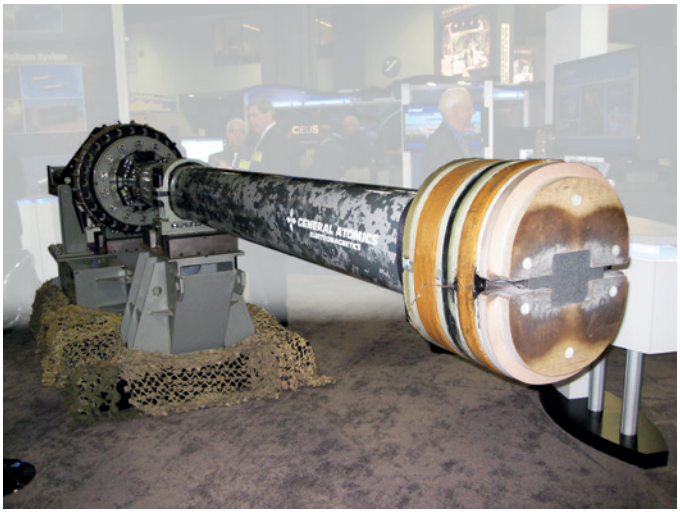
these guns use the repulsive force of electro-magnetic power to propel projectiles. Railguns are based around two parallel metal rails, with a projectile in an armature between them, completing a circuit. A massive electrical current is applied to the rails, creating an electromagnetic field that accelerates the projectile along the rails at extremely high speeds.

This unremarkable heap of scrap is the remains of the first Hänsler LM-2 Elektrischen Geschütz, a 20mm test-bed for the Luftwaffe's six-barrel, 40mm antiaircraft railgun.

The earliest practical railgun was probably that of French inventor Louis Octave Fauchon-Villepleé, who applied for a US patent in July 1917 for an "Electric Apparatus for Propelling Projectiles," receiving the patent in March 1921. His design was offered to the French government in 1918, but the war ended before any serious work was pursued.

This concept was revived during World War II by Otto Muck, a consultant at Siemens in Germany. He proposed a 100m electric coil gun that could hurl 150mm projectiles a range of 250km at a rate of 500,000 rounds per month. This would have required 54,000 tons of coal per month and a power generation system estimated to be 100,000kW. This concept was briefly considered as an alternative to the Röchling HDP multi-chamber gun for bombarding London. It was too preposterous for the Heereswaffenamt, and was rejected as being beyond the state of the art. In the meantime, the firm Gesellschaft fur Gerätbau in Klaist had been studying Fauchon-Villepleé's patent. Under the direction of Dr Joachim Hänsler, the 20mm LM-2 electric gun with a 2m barrel was constructed in 1944, which could fire a 2g aluminum cylinder to about 1,200m/s. The Luftwaffe was suitably interested in a Flak gun based on this principle and released a requirement for a multi-chamber 40mm gun that could fire a projectile with a payload of 0.5kg of high-explosive at the sizzling speed of 2,000m/s. Each gun complex would consist of six railguns with a rate of fire of 12–15rpm, 72–90rpm total, mounted on the massive 128mm Flak 40 carriage. These would be deployed in a regiment of about 70 guns firing 6,000 rounds per minute.

Electromagnetic railguns may be the super guns of the next decade. BAE Systems began demonstrating this EM Railgun for the US Navy in 2010 with a range of 100 nautical miles (185km). The objective is to reach a power of 32 megajoules. (US Navy)



The General Atomics Electromagnetic Systems Group began testing their 3 megajoule Blitzer railgun in September 2010. This fired discarding sabot projectiles at 1,600m/s. The company has proposed versions scaled up to 10 to 32 megajoules power for a variety of tactical applications including field artillery and air defense. This test-bed demonstrator was displayed at the Association of the US Army convention in Washington DC in October 2013.

The work started in early 1945 and never proceeded beyond the paper stage. The US Army captured the LM-2 test-bed gun at the test site in Bavaria. A postwar study concluded that the idea was interesting, but it would have required the electrical power equivalent of half of the electrical power of the city of Chicago to power the Flak regiment, rendering it impractical.

Sir Mark Oliphant of the Research School of Physical Sciences at the Australian National University built a 500 megajoule homopolar generator in 1962 that was later used to power a railgun for scientific experiments. There have been many attempts since then to develop a militarily useful railgun. The numerous experimental guns over the past decades most often faltered due to the deformation of the rail after a few firings as well as their enormous power demands. The US Navy has been a proponent of railgun technology over the past two decades. Warships offer an ideal platform for such weapons since they possess a substantial electric power source. Navy electro-magnetic railguns have set many milestones in railgun technology, including a railgun that fired a 3.2kg projectile at 2,400m/s. The Navy railgun program's motto is "Velocitas Eradico" (Speed Kills). Some analysts believe that railguns may prove practical aboard warships in the 2020s, offering ranges of 150km or more. The US Army has also examined the technology, such as General Atomics Blitzer mobile EMRG. Among its land-based applications would be both long-range field artillery and air defense missions.

FURTHER READING

Most of the guns described in this book have been hidden in secrecy for decades and documentation deliberately destroyed. Not surprisingly, archival material is scarce. Bull and Murphy's account provides the most detailed technical history of the Paris Gun, while the Ehret and Schalich book provides a more thorough account of its operational use. The HDP gun has largely escaped a detailed study, though there are several very good short accounts, especially those by Pallud. There are a number of biographies of Gerald Bull, but the only detailed technical accounts of the Project Babylon guns are the declassified and redacted CIA studies.

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